ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 1.] [1912.

I.—SIR JOSEPH DALTON HOOKER.

1817–1911.

Kew lies, at the beginning of the year, under the shadow of a great sorrow. The veteran Sir Joseph Hooker, Assistant Director during the decade 1855–1865 and Director in the two decades 1865–1885, died at his residence, The Camp, near Sunningdale, in his ninety-fifth year, at midnight on Sunday, 10th December, 1911.

Born at Halesworth in Suffolk on 30th June, 1817, Joseph Dalton Hooker was the second son of William Jackson Hooker and his wife Maria Sarah, eldest daughter of Mr. Dawson Turner, F.R.S., Norwich. His father, at the time of Hooker's birth, was the managing partner of a business which he had been induced to enter in 1809 along with Mr. Turner, whose daughter he married in 1815, and Mr. Paget of Yarmouth, father of the late Sir James Paget, Bart. To so enthusiastic a naturalist and author as the elder Hooker the occupation at Halesworth was not altogether congenial. Towards the end of 1819 he expressed to his friend Sir Joseph Banks a desire to find some position in which his already remarkable and extensive knowledge of botany could be turned to account. Sir Joseph Banks suggested as a suitable situation the Professorship of Botany in the University of Glasgow, which had just become vacant. Hooker's father accepted this suggestion, and in February, 1820, he was appointed by the Crown to the Glasgow chair in succession to Professor Graham, who had been transferred to Edinburgh. He entered upon his duties in May, and the impression which he created may perhaps be best estimated by a remark made in July by Francis Hamilton, one of the ablest and shrewdest men of his time, regarding "the Botanical Garden at Glasgow, where there has been lately appointed a professor likely to be somewhat distinguished." Professor W. J. Hooker occupied the Glasgow chair until 1841, when he was appointed Director of the Royal Gardens, Kew. His son Joseph was therefore educated in Glasgow, passing through the High School to the University, where he attended some of the classes in the Faculty of Arts before proceeding to those in the Medical

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Faculty. In the mathematical class he had as a fellow student a lad somewhat younger than himself, son of a colleague of his father, afterwards to become Lord Kelvin and to follow himself as occupant of the chair of President of the Royal Society. As a medical student he had as a class-fellow the son of another colleague of his father destined like himself to become a distinguished traveller and to be his companion on some of his own most interesting and fruitful journeys. Hooker completed his medical studies and obtained the degree of M.D. at Glasgow in 1839.

While an undergraduate in Glasgow much of Hooker's spare time was given to work in his father's herbarium ; his reading, as he himself has explained, included the study of many works of travel. Among the passages, he tells us, which had especially impressed him were Turner's description of the great peak of Chumlari in the Eastern Himalaya and the account of the island of Kerguelen contained in Cook's Voyages. The latter he was destined to visit himself quite early in his career. At the close of his medical curriculum Hooker became an Assistant Surgeon in the Royal Navy and was gazetted to the " Erebus," then about to start, in company with the " Terror," on an Antarctic expedition under the command of Sir James Clark Ross. In this expedition Hooker held the position of botanist, and in that capacity he was enabled during the next three years to visit New Zealand, Australia, Tasmania, Kerguelen, Tierra del Fuego, and the Falkland Islands. Keen and assiduous, he managed to bring together very large collections of material and to acquire an extraordinary amount of botanical information. While at work on his father's collections, Hooker made his earliest contribution to botanical literature ; descriptions by him of three new Mosses from the Himalaya were published in the ' Icones Plantarum ' in 1837 (vol. ii. p. 194). Before starting on the Antarctic voyage, he had prepared in collaboration with Professor Harvey another paper on Indian Mosses. This, his second publication, appeared in 1840, while he was absent in the southern seas. But if, under paternal inspiration, Hooker thus showed an early inclination for the study of Cryptogams, he would appear to have simultaneously developed an interest of his own in Fossil Botany, because an early contribution to natural knowledge, written and published in Tasmania in 1842 while he was botanist to the circumpolar expedition, gives the results of the examination of specimens of fossil wood from the Macquarie Plains.

Shortly after his return from the Antarctic expedition Hooker, in 1843, became Assistant to Graham, who was still Professor of Botany in Edinburgh and held this position until 1845 when Graham was succeeded in the chair by the elder Balfour. On the termination of his appointment at Edinburgh Hooker became botanist to the Geological Survey of Great Britain. This new appointment naturally gave a great impetus to his palaeontological interests ; while attached to the Survey he made a number of important contributions to the literature of Fossil Botany, the most notable of these being a discussion of the vegetation of the Carboniferous period as compared with that now existing on the globe, which appeared in 1848. But his studies during the period of his appointment in Edinburgh and of his attachment to the Geological Survey

were very far from being confined to palaeobotany. Immediately after his return from the long voyage in the "Erebus," Hooker began the arduous task of preparing for publication the scientific results of his researches in the field. Still under the influence of his early predilection for the study of Cryptogams, he published between 1844 and 1847, sometimes alone, sometimes in collaboration with well-known authorities who had made a special study of particular families, a series of important papers on the hepatics, lichens, mosses, and algae of the subantarctic regions. Nor was this all that he was able to accomplish during the period between 1843 and 1847 ; in or prior to the latter year he collaborated with his father in work on the botany of the Niger expedition, published an enumeration of the plants of the Galapagos Archipelago, and, in conjunction with Mr. Bentham, prepared the manuscript of the Flora Nigritiana, incorporated by Sir W. J. Hooker in his 'Niger Flora' which appeared in 1849. Meanwhile the elaboration of the general antarctic results, the publication of which had begun in 1844, went on steadily, and in 1847 the first section of these results was completed and published in two quarto volumes under the title 'Flora Antarctica.'

With the appearance of this work, however, the task was temporarily relinquished, and Hooker's duties as botanist to the Geological Survey came to an end, in order that he might undertake another expedition more arduous even than the last. The object in view was a double one. His desire was to add to the knowledge already acquired at first hand with regard to the vegetation of temperate and subantarctic regions a corresponding knowledge of the vegetation of some tropical region ; and at the same time to acquire an acquaintance with the vegetation of some large continent commensurate with his knowledge of the floras of so many insular regions. The field of study selected was North-Eastern India, a tract in which but little botanical exploration had been done. The expedition was at first intended to be a private enterprise ; during the course of the preliminary preparations, however, the project was so fortunate as to receive official recognition and to be partly subsidised from public funds. The amount of the subsidy was small, but the indirect effect of the recognition was great, and Hooker found as a consequence that what might otherwise have been difficult became comparatively easy ; indeed some of the results he was able to attain might otherwise have proved impossible of accomplishment. Hooker left England in November, 1847, travelling part of the way as one of the suite of Lord Dalhousie, then proceeding to India to assume the position of Viceroy ; from His Excellency, who took the closest personal interest in the undertaking, Hooker received continued encouragement and constant assistance. Reaching India in January, 1848, Hooker devoted the first three months of the year to journeys in the Gangetic Plain and in Behar, ascending the sacred mountain of Parasnath in Chutia Nagpur. From Behar he made his way to the Himalayas and reached Darjeeling, which became his base of operations, about the middle of April. What remained of the year 1848 and practically the whole of the year 1849 were occupied in the botanical exploration and topographical survey of the State of Sikkim and of the

passes which lead thence into Tibet. While on these high wind-swept passes he was able at least to see, even if he did not reach, that glorious peak of Chumlari which had, from Turner's description, so kindled his boyish ardour to travel. A fortunate accident had gained for him the acquaintance of the great Jung Bahadur; thanks to this, Hooker was given an opportunity, which no one has enjoyed since, of spending the latter part of 1848 in similarly exploring some of the valleys of Eastern Nepal. During most of his sojourn in the Himalayas Hooker travelled and surveyed unaccompanied by any European. But in October, 1849, his friend Dr. Campbell, then the Superintendent of Darjeeling, obtained official permission to visit native Sikkim and joined Hooker. Shortly afterwards the Sikkim Ministry decided that this was an excellent opportunity to take of showing discourtesy to the Indian Government. This discourtesy assumed the form of seizing and maltreating Campbell; Hooker, who was at the same time made a prisoner, they refrained from injuring. Towards the end of December, 1849, the captives were released and the next three months were spent by Hooker in Darjeeling closely occupied in the task of arranging his huge collections and in that of reducing, with the aid of a number of devoted Anglo-Indian friends, the observations made during his survey of the country.

Hooker's old schoolmate and fellow student, Dr. Thomas Thomson, son of one of his father's colleagues in the University of Glasgow, had joined the Indian Medical Service when Hooker entered the Royal Navy. Early in 1847, Lord Hardinge, then Viceroy of India, had deputed Thomson to carry out exploration work in the North-west Himalaya and in Western Tibet, similar to that on which Hooker was engaged in Sikkim. This task completed, Thomson had been accorded permission to proceed to Darjeeling in order to join Hooker. The two friends devoted the year 1850 to a joint botanical investigation of Eastern Bengal, the Sundribuns, Chittagong, Silhet and the Khasia Hills.

Some of the results of Hooker's Indian observations were published by the Asiatic Society of Bengal while he was in India. On his return to England in 1851, he at once resumed work on the materials of his antarctic voyage, the second section of his great work, again in two quarto volumes, being completed in 1855, under the subsidiary title 'Flora Novae Zelandiae.' But while engaged on this and on the subsequent section of the same work, the opening part of which was also issued in 1855, Hooker simultaneously took in hand, largely in collaboration with his friend Thomson, the elaboration of their Indian material. Two very fine illustrated folios dealing with Himalayan species appeared. The first of these, dealing with the Rhododendrons of the Sikkim Himalaya, was edited from Hooker's notes, sketches and material by his father, and issued between 1849 and 1851; the second, a volume of illustrations of Himalayan plants, chiefly made on behalf of an Indian friend, Mr. Cathcart, in the neighbourhood of Darjeeling, was edited, with descriptions by Hooker himself, in 1855. During this period, Hooker and Thomson collaborated in the preparation of a 'Flora Indica,' the first and only volume of which appeared in 1855; in the previous year, Hooker had published his 'Himalayan Journals,'

one of the best books of travel ever written, in which the results of his Indian journeys, botanical and non-botanical, are summarised. It is sometimes forgotten that as a traveller Hooker, with his wide range of knowledge and his almost illimitable interests, did not confine himself to botanical observations. It is true that no botanical field-work has been more full of interest or has proved of greater value than that done by Hooker in Sikkim, and it is perhaps natural for those whose studies are confined to botanical problems to look upon this work as the chief harvest garnered by Hooker in the Eastern Himalayas. But it is probable that the trained surveyor would join issue with the botanist and would declare that however valuable Hooker's botanical results may have proved, his topographical results were of even greater importance. If the political consequences be taken into account the surveyor's view must be accepted as the more just. These topographical results, after their reduction, formed the basis of a map published by the Survey of India. This map has proved so accurate and so detailed as to have enabled the Government of India to carry out with success more than one political mission and more than one military campaign. The active publication of Hooker's Indian results ceased for a time with the return to India of Thomson and with the appointment of Hooker in 1855 to the post of Assistant Director at Kew under his father. During the period between his return from the Indian journeys and his appointment to the Kew staff, Hooker and Thomson accomplished the task of arranging and approximately identifying their own extensive collections of Indian plants with a view to the distribution of their duplicates. Before this work had been completed the Indian collections of Falconer, Griffith, and Helfer, made over to Kew from the cellars of the East India House, had to be dealt with in the same manner. The latter task had not been completed when Thomson departed, but another smaller though very important one was successfully accomplished. Besides the three collections mentioned, the residuum of the Indian Herbarium distributed by Wallich on behalf of the Honourable East India Company was also entrusted to Kew. The distribution of this great collection took place between 1828 and 1832 ; there was consequently no set of its plants at Kew. In this Kew did not stand alone, the herbarium attached to the Royal Botanic Garden, Calcutta, at whose cost and for whose benefit the collection had to be brought together, was in like case. By a happy chance the friends were thus enabled to fill more or less satisfactorily a great hiatus in the herbaria of both gardens ; a set, fairly complete, so far at least as the plants collected by Wallich himself are concerned, was made up and laid into the herbarium at Kew, while a similar set was taken to Calcutta by Thomson. The early inclination towards the study of Cryptogams found no opportunity of asserting itself between 1851 and 1855 ; that towards palaeobotanical studies, though not completely inhibited, because several interesting contributions to our knowledge of fossil botany were published by Hooker during the years 1853 to 1855, was less active than it had been before he sailed for India in 1847.

The period during which Hooker was Assistant Director at Kew was one of extraordinary activity. During the ten years that he

held this position he was throughout closely occupied with his sub-antarctic work, the third section of which, under the subordinate title 'Flora Tasmaniae,' was completed in 1860. In some respects the Introductory Essay to this work, on the origination and distribution of species, is the most important of Hooker's many important contributions to scientific literature. In intrinsic value, it is second to none of his writings; it is second to none in its philosophical character. Its chief interest and importance is, however, an extrinsic one, for it fully explains and amply justifies the action taken by Hooker when, in conjunction with Lyell, he prevailed on his friend Darwin to publish, in 1858, a preliminary sketch of his epoch-making hypothesis. This essay had hardly appeared when Hooker was able to make yet another journey and add still further to his knowledge of topographical botany. In the autumn of 1860, he accompanied Captain Washington, Hydrographer of the Royal Navy, on a scientific visit to Syria and Palestine. During this visit an ascent was made of Mt. Lebanon and as a result Hooker published, two years later, an interesting and valuable paper on the cedars of Lebanon, Taurus, Algeria and India. Much of the information gained during this journey was embodied in a masterly sketch of the botany of Syria and Palestine, published in 1863 in Smith's Bible Dictionary. On his return from Syria we find Hooker closely occupied in working out the results to be derived from a study of the plants of the northern circumpolar regions. This subject, cognate to much of his work connected with corresponding southern regions, had first received his attention in 1856, when working out the collections brought together during the Franklin searches; he returned to it in 1861 when dealing with those collected in the M'Clintock expedition. In the following year he dealt with the subject in a comprehensive fashion in his 'Outlines of the distribution of Arctic plants,' a paper that is one of the classics of phytogeography. But while all this was in progress he undertook the contribution to the series of Colonial Floras prepared under Government authority at Kew, of a 'Hand-book of the New Zealand Flora,' in two volumes, the first of which appeared in 1864.

The period while Hooker was Assistant Director was also marked by the publication of three important papers, more restricted as to subject, but of the highest value as contributions to our knowledge of morphological botany. These were a study of the structure and affinities of the *Balanophoreae*, published in 1856; a study of the origin and development of the pitchers of *Nepenthes*, published in 1859, and a study of the genus *Welwitschia*, published in 1863. The second of these studies had also an important physiological bearing.

Another group of phytogeographical problems occupied Hooker's attention during this period. They had indeed been before him almost from the commencement of his active career, and his interest in them dates from his own visits, made on the way to the circumpolar regions, to the Azores, Madeira, the Canaries, Cape Verde Islands, St. Paul's Rock, Ascension, St. Helena and South Trinidad. But the problems were as imminently present in connection with his visits to other islands and in connection with his studies of the vegetation of the Galapagos Group in 1847, and of Raoul in the Kermadec

Group in 1856. It is therefore only proper to assign to this period the formation of the views to which expression was given in a discourse on 'Insular Floras' at the Norwich meeting of the British Association in 1866, the year following its close.

During this period, Hooker continued, in conjunction with Thomson, the floristic work based on their Indian collections. Their 'Flora Indica,' the only volume of which had been issued in 1855, was indeed definitely abandoned. But during the years 1858 to 1861 the two friends published a series of 'Praecursores' dealing with the species of a number of important natural families of Indian plants. Hooker also took a very considerable share between 1858 and 1864 in the preparation of Thwaites' enumeration of the plants of Ceylon, and was responsible for the preparation and issue, in 1865, of the catalogue of the specimens distributed from the herbaria of Falconer, Griffith and Helfer.

If during this period we find no further palaeobotanical contributions, there is evidence that his interest in the flora of Africa, lit up by his visits to the Cape Verde and other islands in 1839, further manifested in 1847 and 1849, and again shown in 1852, 1854, 1860 and 1861 had not abated, because in 1862 and again in 1864 he dealt critically with the important collections made by Mann in Fernando Po and the Cameroons; in 1865 he described some new and interesting African species of *Aristolochia*; in 1868 and 1871 he contributed to the 'Flora of Tropical Africa.' But the most important systematic work undertaken during the time that Hooker was Assistant Director has still to be mentioned. He began in collaboration with Mr. Bentham the preparation of a 'Genera Plantarum,' based principally on the material contained in the herbarium at Kew. The first portion of this, one of the most important botanical works of the nineteenth century, was issued in 1862, and the first volume, ending the *Calyciflorae*, was completed in 1865.

The death in that year of the illustrious Sir W. J. Hooker was followed by the succession of his son to the post of Director of the Royal Gardens, Kew. This post Hooker occupied during the next twenty years. The onerous administrative duties of this position did not, however, interfere with the prosecution of the work he already had in hand. The New Zealand flora for the Colonial Floras series had indeed already been nearly completed, the second and concluding volume was issued in 1867. He continued to take his share in the preparation of the great 'Genera Plantarum,' the second volume of which was issued in 1876, the third and concluding one in 1883. With the succession to the Directorship came also succession to the editorship of the 'Botanical Magazine' and of the 'Icones Plantarum,' both of which he continued to issue after his own retirement in 1885. His father's death added to Hooker's duties also that of replacing, by his own 'Students' Flora' published in 1870, the well-known 'British Flora.' He also annotated and rearranged the natural families of plants in the English edition of Le Maout and Decaisne in 1873, and in 1876 he wrote one of the most difficult to prepare but one of the most effective of his publications, the volume on 'Botany' for the series of Science Primers.

The exacting character of Hooker's duties as Director did not entirely debar him from further botanical travel, for he was able to

take part with the late Mr. J. Ball and Mr. G. Maw in an expedition to Morocco and the Atlas range in 1871, during which the party made the first ascent by European travellers of the peak of Jebel Tezah. An account of the ascent of the range was published by Hooker in 1871 ; the botanical results were formally dealt with by Ball in 1873. A general account of the expedition under the title 'A tour in Marocco and the Great Atlas,' written by Hooker and Ball in collaboration, was published in 1878. This journey and its journal are not, however, the only indications that Hooker's interest in the botany of the Dark Continent continued unabated, for he dealt with one of the most interesting of the problems connected therewith in a paper on the subalpine vegetation of Kilimanjaro in 1875, and the subject of tropical African mountain floras was again alluded to by Hooker in 1884. But in this case the peculiar interest he took in the subject was of a general rather than a local nature and was closely associated with the interest still taken in the distribution of Arctic plants, which was manifested once more in a paper published in 1874, and with his interest in the vegetation of remote islands in the southern seas, shown in papers on the plants of Tristan d'Acunha published in 1875 and on those of Kerguelen published in 1879. The whole subject of Geographical Distribution was exhaustively summarised by Hooker in his sectional address delivered at the York meeting of the British Association in 1881.

The African journey of 1871 was not, however, the only one that Hooker was able to make while Director of Kew. In 1877, in company with his friend Dr. Asa Gray, and with Dr. Hayden of the United States Survey, he paid a botanical visit to Colorado, Wyoming, Utah, the Rocky Mountains, the Sierra Nevada and California. Hooker's interest in the vegetation of the New World had so far found little opportunity of manifesting itself. That it had existed as long as the interest he took in the flora of Africa we know from the fact that his earliest paper on the subject, dealing with a species from the Andes of Colombia, dates from 1847, while his first note referring to the vegetation of North America dates from 1853. If the only manifestation of this interest during the fruitful period of his Assistant Directorship be a note on a New Brunswick fern published in 1865, we know that it was still active because to that period belongs some of the work expended on the monograph of *Rosaceae* contributed to the 'Flora Brasiliensis' which was published in 1867. The results of Hooker's visit to North America ten years later were summarised by himself in 'Nature' in the same year, formed the subject of an address to the Royal Institution in 1878, and were embodied in a contribution by Gray and himself to the United States Survey Reports in 1882.

The heavy administrative duties which marked the period from 1865 to 1885 must not be overlooked. While Director at Kew, the condition and arrangement of the collection of hardy trees and shrubs were matters of special concern to Hooker, and the Pinetum was entirely his creation. The valley near the Flagstaff, known as the Berberis Dell, was brought into its present condition between 1869 and 1872. The Rockery or Alpine Garden was created in 1882. Numerous avenues, grassed drives and gravel paths were

opened out or planted during his Directorship, especially in the Arboretum. To mention only a few of these, the Thorn avenue was planted in 1868, that of Atlas Cedars was planted in 1871, the Holly walk in 1874, the Sweet Chestnut avenue in 1880. A new system of supplying water was established between 1866 and 1868; the stables were removed to a more suitable site in 1867 and their removal enabled the opening of the present Cumberland Gate. The drawbridge and entrance known as the Isleworth Gate was provided in 1872.

The range of plant-houses known as the T-range was erected in 1868–9; the Jodrell Laboratory was added to the institution in 1876; a new hall, added to the Herbarium building, was completed in 1877; a wing was added to No. I. Museum in 1881, and the North Gallery was completed and opened to the public in 1882.

With all the burden of these duties upon him Hooker was still able to take his full share of the public work that falls to be performed by men of science. In 1866 he undertook to deliver one of the evening discourses at the Nottingham meeting of the British Association; the subject, 'Insular Floras,' has already been alluded to. In 1868 he was President of the meeting of the Association held at Norwich, and his opening address, which dealt with the value and functions of museums, was prefaced by an unqualified advocacy of the acceptance of the hypothesis of his friend Darwin as the surest means of promoting natural knowledge, which produced a marked and lasting effect on scientific thought. In 1874 he was chairman of the department of Zoology and Botany in the Biological section at the meeting of the Association in Belfast, taking as his subject the carnivorous habits of plants and reviewing a group of problems to which his own observations and researches on *Nepenthes*, published in 1859, had drawn especial attention. In 1881 he presided over the Geographical section of the Association at its meeting in York and delivered an address on 'Geographical Distribution' of the greatest importance and value.

In 1873 Hooker was chosen to fill the highest post to which an English man of science can attain—the Presidentship of the Royal Society; he occupied the presidential chair during the next five years. As our record indicates, the exacting duties which this position entails neither interfered with the performance of his administrative work nor curtailed his activity as a botanical author. To this activity we again turn in order to record the commencement of what was to prove in some respects the heaviest and most sustained of the tasks of his life. The distribution of the Indian specimens on which Hooker and Thomson had been engaged was hardly completed when a similar necessity arose through the accession of the Peninsular Indian herbarium of Dr. Wight. The catalogue required for this collection was ready for issue and the preliminary work completed by 1870. The preparation of a 'Flora of British India' on the lines of the Colonial Floras prepared at Kew could at last be begun. The opening part of the first volume was issued in 1872 and the volume completed in 1875. The second volume was completed in 1879, the third in 1882, and the fourth in August, 1885. Three months later Hooker retired from the Directorship of Kew, taking up his residence at the Camp, near

Sunningdale, where he had built a house and laid out a charming and well-furnished garden.

If retirement, in Hooker's case, meant release from the cares of administration, it did not mean leisure. He continued to edit the 'Icones Plantarum' for four more years, until the end of 1889, and the 'Botanical Magazine' for the next 17 years, until 1902, when he associated with himself in this task Mr. W. B. Hemsley, with whose assistance he supervised the volumes for 1903 and 1904. With the completion of the volume for that year, the one hundred and thirtieth of the series, his connection with the historic serial came to an end. These two enterprises, however, were trifling as compared with the heavy task connected with the Indian Flora, nearly half of which had still to be done. Its preparation went on with the steadiness that had marked the progress of the earlier volumes. The fifth volume, containing four parts—the earlier volumes only including three each, was finished in 1890; the sixth, also a volume of four parts, was completed in 1894; the seventh and concluding volume appeared in 1897. While this volume was being written, Hooker arranged for publication a Century of drawings of orchids, for which he provided the descriptions, selected from among the botanical drawings belonging to the Calcutta herbarium, which had been placed at his disposal while preparing the fifth and sixth volumes of the 'Flora.' This 'Century of Orchids,' a large quarto, was published in 1895.

Meanwhile, however, Hooker had undertaken the superintendence of another heavy task. His friend Darwin, some time before his death, informed Hooker of his intention to devote a considerable sum to meet the cost of some work of utility to biological science, and to arrange that this might be completed if it were not finished during his own lifetime. His difficulties in connection with his own studies led Darwin to suggest that the work should consist of an index to the names, authorities and countries of all flowering plants; Darwin requested Hooker to undertake the supervision and direction of its preparation. This Hooker did, the compilation of the index being entrusted to Mr. B. D. Jackson. The result is the 'Index Kewensis,' a work with regard to which the feeling is one of incapacity to understand what its absence implied. The issue of this Index occupied the period from 1893 to 1895.

The responsibility connected with the 'Index Kewensis' had barely ended ere Hooker arranged, as an act of justice to the memory of Sir Joseph Banks, to edit the 'Journal' kept by that naturalist during Captain Cook's first voyage, 1768–71; this edition was published in 1896. Just as this volume appeared an appeal was made to Hooker to undertake the completion of the 'Handbook to the Flora of Ceylon' begun by Dr. Trimen, but of which only three parts had appeared when Trimen died. Hooker responded to the appeal, and in 1898 the fourth part, edited to some extent from manuscript left by Trimen, was issued from the press; the fifth and concluding part, which Hooker had to write himself, was published in 1900.

The next two years were devoted to the preparation of a life of his father, Sir William Jackson Hooker, the first Director. This life appeared in December 1902, simultaneously with the

arrangement which relieved him of the heavier part of the work connected with the 'Botanical Magazine.' The relief which this arrangement brought was, however, more than compensated for by the inception of yet another task. He undertook, at the request of the Government of India, to prepare for a new edition of the 'Imperial Gazetteer' a sketch of the vegetation of the Indian Empire. This extremely difficult task was successfully accomplished; the sketch was published in 1904, the year in which Hooker's connection with the 'Botanical Magazine' was finally severed.

In seeking for a subject to occupy the leisure which had at last arrived, Hooker selected one that sufficed to occupy the remaining years of his life. Among the natural families of Indian plants with which he and Thomson had dealt in their 'Praecursores,' one of the most interesting and at the same time one of the most difficult had been the *Balsamineae*, their account of which was published in 1859. Wight and Beddome both subsequently gave especial attention to the South Indian members of this group, and in 1874 Hooker himself dealt with them once more in the 'Flora of British India.' But during the 30 years which had elapsed many new Indian and Chinese forms had been collected; the characters of some of these appeared to invalidate earlier conclusions. To the study of these plants, so varied in form and so intricate in their relationships, Hooker devoted his attention almost exclusively from 1904 onwards, with the most satisfactory results. In the course of his studies he received the most willing assistance in the form of the supply of material from those in charge of the leading herbaria in Europe; in return he has placed those herbaria under a lasting obligation by providing them with a uniform system of determinations of the specimens they contain. On this work which, at any rate as regards the Asiatic species, has been practically completed, Hooker was engaged almost to the end of his life.

In this sketch of what Hooker was able to accomplish during the seven decades over which his active working career extended, allusion has been made only to those contributions to material knowledge which are primarily scientific. It has further to be pointed out that even in this limited review no attempt has been made to provide an exhaustive summary of his scientific botanical results. This, it may be remarked, can only be properly done when the task of writing a life of Hooker is undertaken. Nor has even passing allusion been made to what was an ever-present motive in all that Hooker did, the application to practical and commercial ends of the scientific knowledge which we owe to his labours. The decision to exclude such references from our sketch has been twofold. The object in view has been to provide material for an estimate of the nature of his studies as guided by personal inclination and as affected by external conditions. On the other hand, his purely economic results, unlike his primarily scientific ones, have been very compactly presented. If we except a few economic papers, such as his report on substances used as food, prepared at the time of the Great Exhibition of 1851, with one or two minor papers between 1851 and 1855, and again some minor papers from

1886 onwards, practically the whole of his economic contributions are to be found in the series of 'Kew Reports' published by his father between 1855 and 1865 while Hooker was Assistant Director, and in the same series from 1865 onwards while he was Director at Kew.

Nor has more than passing allusion been made to the fact that in fields of study other than botanical his interest was as keen and his contributions to knowledge were as valuable as those in the science which he primarily served. Regarding his services to geography, it is hardly necessary to say more than has already been said, save to point out that these services were as great and equally effectively rendered on the technical side by his work as a topographical surveyor and cartographer, and on the philosophical side by his contributions to phytogeography. But his services to geology have also been of lasting value, and here again not only on the palaeontological side but in that interesting region wherein geology and physiography join hands. If study on the former side was given up under the pressure of other duties somewhat early in his career, the interest in the subject never abated; that his interest in problems relating to physiography remained unimpaired is indicated by his recurrence to the subject in a short note on the evidences of ancient glaciers in Central France published in 1876. His zoological interests, too, were as keen as his physiographical, and, at all events in the earlier part of his career, were by no means confined to the bearing of zoological evidence on questions of distribution. One of his earliest papers, published in 1845, is a note on marine animals brought up by deep-sea dredging during the Antarctic voyage; his Himalayan Journals, too, are replete with important zoological field-notes. The science of meteorology, too, was included in the wide field over which Hooker's interests extended; another early contribution, published in 1848, deals with the temperature of the soil in Egypt, while the Himalayan Journals are again replete with valuable meteorological information which had already been presented in a compact and illuminating manner in a paper on the climate and vegetation of East Nepal and Sikkim published in 1852.

If the record of Hooker's contributions to scientific botanical literature be examined more closely we find that in the environment created by the presence of his father's collections in Glasgow, Hooker developed a strong inclination for work connected with Cryptogamic plants. This inclination was manifested in his two earliest papers, written before he departed on his Antarctic voyages. It reached its maximum during the period 1844 to 1847, between his return from the Antarctic and his departure for India, his range of study including hepatics, mosses, lichens, seaweeds and diatoms. But the wider problems relating to the distribution and even to the nature of species, as to which the evidence of cryptogamic plants, with their more extended range, is not so effective as that afforded by phanerogams, led to his giving greater attention to the latter, and Hooker practically abandoned sustained cryptogamic study when he left for the East.

We find, however, that at almost as early a period Hooker developed a strong inclination for palaeobotanical study. This

inclination is shown in an early paper written and published while he was botanist on the "Erebus." The inclination, as was natural, was at its maximum while he was attached to the Geological Survey. It was still manifest, though less markedly so, after his return from India. His last addition to this field of knowledge appeared in 1855; after he became Assistant Director, Hooker did not again actively engage in palaeobotanical study.

If from this period onwards Hooker's work had as its material mainly phanerogamic plants, that work was of the most varied character. It is not difficult to trace the existence, at different periods of his career, of certain dominant interests. Unlike not a few distinguished travellers Hooker did not amass material and then leave it unelaborated. He is, on the contrary, one of the few exceptional men who have been in a position to say that they had ploughed their furrow to the end. Vast as were the collections he had accumulated, before his life ended he had dealt with them all. The circumstances under which his collections had been made of necessity compelled him to deal with them on a floristic basis. The earliest of his collections being those made during his southern voyage, the southern collections were attacked first. The work began immediately on his return to England, and as we have seen, its three geographical sections were dealt with in detail, beginning with the Antarctic and sub-Antarctic section. But we find, from papers published in 1844, that both the New Zealand and Tasmanian sections were already occupying his attention. During the years 1845 to 1847, while the dominant interest was in Antarctic plants he paid no little attention to the Tasmanian flora, this interest culminating in the Tasmanian 'Spicilegium' of 1847, the appearance of which was coincident with the completion of the 'Flora Antarctica' and with his own departure for India. From 1844 till his resumption of work in 1851, the New Zealand interest was in abeyance. The Antarctic work, however, lighted up a new interest which extended its scope, and led to the simultaneous examination of the evidence afforded by isolated islands or island groups in regions other than the sub-Antarctic. This cognate interest, which persisted long after the Antarctic work proper was completed, is shown in papers published in 1846 and 1847, again in 1856, 1857 and 1861, and yet again in 1875 and 1879.

When active work on the collections made in the Southern Seas was resumed after the completion of his Indian journeys, it was to the New Zealand section, hitherto left practically untouched and not to the Tasmanian ones which had occupied him before his departure, that his attention particularly turned. This fresh New Zealand interest was the dominant one until 1855, when Hooker became Assistant Director. But immediately the New Zealand work was over Hooker reverted to the Tasmanian collections, which provided what was his dominant interest until 1859. However, even during this period, the New Zealand interest still asserted itself; he published papers dealing with New Zealand plants in 1857, 1859 and 1860, and the interest again became a dominant one from 1862 till 1867, during which period he prepared the New Zealand 'Handbook.' Meanwhile a new interest, complementary to, and in a manner arising out of the sub-Antarctic work, manifested itself. This was his

interest in Arctic vegetation, a subject he was to make peculiarly his own, which is shown in floristic contributions published in 1856, 1861 and 1873.

But collateral with the strong interests arising out of his own experiences in the field we find that another marked inclination ran through his work up to 1865, when he became Director of Kew. This was his interest in the vegetation of Tropical Africa, evidenced by important floristic contributions to knowledge in 1847, 1849 and 1852, and again in 1860, 1862, 1864 and 1865. This interest was further manifested in the systematic treatment of certain genera and families in 1868 for the first volume and in 1871 for the second volume of the 'Flora of Tropical Africa,' and showed itself again in 1874, but this time in a modified form, in connection with his studies of mountain floras, a subject cognate on the one hand with his Antarctic and Arctic work, on the other hand with his investigations of Insular Floras.

We find from his papers, that as early as 1847 Hooker was ready to deal with American plants as well, but if we except his substantial floristic contributions to the 'Flora Brasilensis,' published in 1867, there is no evidence that a floristic interest in American plants was ever strong. His first definite treatment of a North American plant only dates from 1874, and its mention at all is in connection with its distribution, not with its characters. The very great interest which he did subsequently take in the North American vegetation as the result of his visit to the United States in 1877 was, as we shall see, phytogeographical and not floristic.

From the time of his Indian journeys Hooker's interest in the Indian Flora was as intense as that which he took in the floras dealt with in his 'Botany of the Antarctic voyage' and, thanks to the assistance of his father, a very substantial floristic contribution, based on his material and his field-descriptions was made as early as 1849. Thanks largely too, to the fact that he had the collaboration of his friend and fellow-traveller Thomson, much was accomplished even while the burdens of the Tasmanian and New Zealand floras lay heavily on him and hardly a year passed between 1854 and 1864 without some substantial contribution, either from his own pen or with the collaboration of Thomson, to the floristic study of the vegetation of India, Malaya and Ceylon. But while he was, as we have seen, able to get through the heavy task of the preliminary arrangement of his Indian material in the meantime, the publication of Indian floristic work was in abeyance between 1864 and 1872. As a matter of fact when the New Zealand interest ceased to be dominant in 1867 Hooker's floristic interest was transferred to the British Isles, and this British interest remained the dominant one until in 1870 the 'Students' Flora' appeared. But, this task ended, and the preliminary sorting of the Indian material accomplished, the dominant interest was that which centred in the flora of India. This interest may be said to have remained the dominant one for the rest of Hooker's life. Not only did it continue to be so without a break from 1872 when the first part of the Flora of British India was published till 1897 when that work was completed ; it was prolonged till 1900 in connection with the Ceylon Handbook and was revived by the

necessity for the sketch of the vegetation of India issued in 1904. Moreover, the work on the *Balsamineae*, which occupied his life from 1904 till 1911, although it gradually became extended to the whole of eastern and south eastern Asia, had its origin in a monographic study of the Indian species of *Impatiens*.

If, however, so much of Hooker's work has, as the result of his own indefatigable field-work, been of necessity thrown into a floristic mould, this floristic study has been so thorough that all his writings are mines of wealth alike to the systematist, to the morphologist and to the student of botanical philosophy. Nor has he been prevented by the heavy floristic duties which the circumstances of his career imposed upon him from entering with success these various fields of study. So far as his contributions to pure system are concerned it is only necessary to mention his share in the production of the 'Genera Plantarum' between 1860 and 1883. His contributions to pure morphology include his classic papers on *Balanophoreae* in 1856, the ovary of *Siphonodon* in 1857, *Nepenthes* in 1859, and *Welwitschia* in 1863. The *Nepenthes* paper is also important on the physiological side, and its bearing in this direction was more fully developed by Hooker in an address on the habits of carnivorous plants in 1874.

But it is to his contributions to the field of botanical philosophy that Hooker largely owes his place in the roll of fame. His floristic work, though done by the hand of a master, is after all work that, if not done so well, might still have been done by others. But the philosophical papers which commence with his share in the Introductory Essay to the 'Flora Indica' in 1855 and end with his sketch of the vegetation of India in 1904, are those in which stand revealed the teacher we have lost. The first Indian Essay was followed in 1860 by that on the origination and distribution of species prefixed to the 'Flora Tasmaniae,' in 1861 by that on the distribution of Arctic plants, in 1862 by his masterly account of the Cedars, in 1863 by his sketch of the vegetation of Syria and Palestine, in 1866 by his discourse on Insular Floras, in 1867 by his remarks on the struggle for existence as plants, in 1868 by that portion of his address at Norwich which deals with the Darwinian hypothesis, in 1877 and 1878 on the features of the North American flora, in 1881 by his address on Geographical distribution, and in 1882 by his paper on Tropical African Mountain Floras. It is singularly appropriate that this series of masterpieces should end in 1904 as they begin in 1855 with an essay on the vegetation of India, his work connected with which had occupied his almost unbroken attention for a quarter of a century. A feature of these philosophical contributions which arrests the attention of the reader and compels admiration, is the style in which they are written. To this gift of style is due the fact that the 'Himalayan Journal' in which it is equally displayed has, without reference to its scientific contents, been described as one of the best books of travel ever written and has also been characterised as the best guide book ever published. As a man of letters Hooker may be regarded as deserving a position only second to that which he attained as a man of science.

In an appreciation contributed to 'Nature' by his devoted friend Dr. Asa Gray, in 1877, an estimate is given of the quality of

Hooker's work. The fact that of Hooker's most intimate friends and contemporaries Gray was the one who, by stress of circumstance had been, in spite of his versatile talents and varied interests, compelled in the same manner to devote most of his attention to floristic work renders this appreciation doubly valuable. Such as it is, we can only say that what was put on record then applies equally to what has happened since. In this article, written when Hooker was in his sixtieth year, Gray expressed the hope that he might be writing of one who was only in mid-career, a hope that has almost been fulfilled. Nor of Hooker's activity as an administrator need more be said than what Gray has said; it was exercised "in such wise as to win, along with national applause, the gratitude of the scientific world."

Hooker was elected a Fellow of the Linnean Society in 1842, of the Geological Society in 1846, and of the Royal Society in 1847. He served on the Council of the Linnean Society for 24 years, during 15 of these as a Vice-President. On the Geological Society Council he served six years. He also served on the Council of the Royal Society for 17 years, during six of these as a Vice-President and during five as President. He was a correspondent of the Institute of France and an honorary or corresponding member of most of the academies, societies and associations founded for the promotion or application of natural knowledge. Many of these societies bestowed on Hooker still further distinctions. The Royal Society submitted his name for the award of a Royal medal in 1854, and awarded him the Copley medal—the highest honour the Society can bestow—in 1887 and the Darwin medal in 1892. The Linnean Society awarded him the Linnean medal in 1888, and presented to him, in 1897, a medal struck to commemorate his own eightieth birthday and, in 1908, one of the medals struck to commemorate the fiftieth anniversary of the publication of the joint communication by Darwin and Wallace on natural selection, Darwin's share in which was so largely the result of Hooker's action. The Society of Arts awarded him their Albert medal in 1883, the Geographical Society their Founder's medal in 1884, and the Manchester Philosophical Society a medal in 1898. Finally, in 1907, the Royal Swedish Academy, under circumstances already described in this work (*K.B.* 1907, p. 259), conferred upon him what he has himself termed the crowning honour of his long life—the unique medal struck to commemorate the two-hundredth anniversary of the birth of Linnaeus. The University of Oxford conferred on him the honorary degree of D.C.L.; he received the honorary degree of LL.D. from the Universities of Cambridge, Edinburgh, Dublin and Glasgow. In 1869, after he was President of the British Association at Norwich, he was made a C.B.,; in 1877, when about to vacate the Presidentship of the Royal Society, he was created a K.C.S.I.; in 1897, when the 'Flora of British India' was completed, he was made a G.C.S.I.; in 1907, on his ninetieth birthday, he received the Order of Merit. His foreign distinctions included membership of the Royal Swedish Order of the Polar Star—to which in his day Linnaeus had belonged—and of the Royal Prussian Order "Pour le Mérite."

Even in his old age Hooker felt it his duty to respond to invitations to take part in public ceremonies designed to

commemorate occasions of signal importance. Only the distance to be traversed, combined with the weight of his 90 years, prevented him from being present at Upsala in 1907 to do honour to the memory of Linnaeus. In 1908 he not only attended the celebration by the Linnean Society of the fiftieth anniversary of its publication of the joint contribution by Darwin and Wallace, but addressed the delegates and Fellows present in a speech which recounted the part he had been able to take 50 years before. Again, in 1909 he attended—and was the central figure of the occasion—the celebration by the University of Cambridge of the centenary of the birth of Darwin.

At work until within a short time before his death, and keenly interested in current topics and in the latest contributions to natural knowledge till the last, Sir Joseph, whose physical strength had been gradually diminishing since August, died peacefully and painlessly in his sleep. The invitation to receive his ashes in Westminster Abbey was befittingly made. But Sir Joseph had expressed his wish to be buried in the family vault at Kew. There he was laid to rest on Friday, December 15. The funeral took place from the house so long occupied by his father and himself.

Among the mourners were the following members of Sir Joseph's family, representatives of societies and institutions, and others :—

Lady Hooker, Miss Hooker, Mr. W. H. Hooker, Mr. C. P., Mrs., and Mr. E. Hooker, Mr. R. H. Hooker, Mr. R. S. Hooker, Sir W. T. Thiselton-Dyer, Miss Thiselton-Dyer, Mr. G. H. Thiselton-Dyer, Mrs. Whitfield, Mrs. Calverley Bewicke, Mr. R. Woodward, Mr. R. Woodward, junr., Rev. Canon Barker, Mr. G. Barker, Mr. L. Barnard, Mrs. Crowder, Mr. M. Malleson, Mr. J. Murray, Miss G. Palgrave, Mrs. Paul Waterhouse, Capt. A. L. Henslow, Miss Symonds, Mr. R. Symonds, Miss M. Smith, Sir Arthur and Lady Rücker, Mr. T. Maskelyne, Mr. T. A. Rising, Dr. Trail, Rev. A. G. Musgrave, Mr. M. Pitkin; the servants from The Camp, Sunningdale; Royal Society: Sir A. Geikie (President), Sir J. Larmor and Sir J. R. Bradford (Secretaries), Lt.-Col. A. W. Alcock (Council), and Prof. Bayley Balfour, Regius Keeper of the Royal Botanic Gardens, Edinburgh; Society of Antiquaries: Dr. C. H. Read (President); Linnean Society: Dr. D. H. Scott (President), Dr. B. D. Jackson and Dr. O. Stapf (Secretaries); Geological Society: Prof. W. W. Watts (President) and Prof. J. W. Judd (Past-President); Royal Geographical Society: Mr. W. E. Darwin and Lt.-Col. H. H. Godwin-Austen; British Science Guild: Sir Norman and Lady Lockyer; Entomological Society: Prof. R. Meldola; British Medical Association: Mr. G. A. Peake; Royal Horticultural Society: Sir D. Morris; Pharmaceutical Society: Mr. E. H. Holmes; University of Glasgow: Prof. F. O. Bower; Natural History Museum: Mr. E. G. Baker; West Indies: Mr. W. Fawcett; Royal Botanic Gardens, Kew: The Director and Assistant Director, with all the members of the permanent staff, and with detachments representing the constabulary and the labour departments; Miss Baker, Mr. A. E. Bernays, Mrs. Bliss, Prof. G. S. Boulger, Mr. J. Britten, Mr. C. H. Curtis, Prof. Sir G. H. Darwin, Hon. Mrs. H. Darwin, Dr. F.

Darwin, Mr. G. C. Druce, Mr. J. R. Drummond, Miss A. Eastwood, Mr. J. S. and Mrs. Gamble, Mr. W. Goldring, Mr. G. Gordon, Dr. A. C. L. Günther, Mr. R. W. T. Günther, Mr. F. Günther, Mr. W. B. Hemsley, Mr. A. Henry, Mrs. Judd, Mrs. de Courcy Laffan (representing Lady Flower), Surgeon-Gen. Lock and Mrs. Lock, Mr. A. H. Lyell, Capt. F. H. Lyell, Rev. J. B. and Mrs. McClellan, Miss Mead, Prof. D. Oliver and Mrs. Oliver, Prof. F. W. Oliver, Mr. R. Hooper Pearson, Mrs. Prain, Mrs. D. H. Scott, Mrs. W. Sharpe, Mr. Miles Stapylton, Lieut.-Col. Strachey, Mrs. and Miss Thurston, Mr. F. A. Turner, Mr. H. J. Veitch, Prof. S. H. Vines, Dr. F. N. Williams, Dr. R. W. Wilson, Miss Wrigley, Miss Younghusband, Mrs. Borlase, Mrs. and Miss Fitch, Miss Garden, Mrs. Goldney, Mr. L. Huxley, Miss B. Kent, Miss Peel, Miss M. Smith, Miss F. Smith, Mr. and Mrs. Soltau, Mrs. Tyndall. Among those who expressed their regret at being prevented by circumstances from being present were Mr. W. and Mrs. Gardiner, Mr. M. Horner, Sir E. Ray Lankester and Prof. J. W. H. Trail.

List of Works by the late Sir Joseph Hooker.

1837.

Polytrichum semilamellatum, *Grimmia laxifolia*, *Glyphocarpa Roylei*, nn. spp. (Hook. Ic. Pl. 1837, vol. ii. t. 194.)

1840.

Musci Indici; or list of Mosses collected in the East Indies by Dr. Wallich (by W. H. Harvey); to which are added those collected by Dr. Royle in the northern part of India (by J. D. H.). (Hook. Journ. Bot. 1840, vol. ii. pp. 1–21.)

Contributions towards a Flora of Van Diemen's Land, chiefly from the collections of Ronald Gunn, Esq., and the late Mr. Lawrence. (Hook. Journ. Bot. 1840, vol. ii. pp. 399–421.)

Entosthodon obtusifolius, *E. Mathewsii*, *E. latifolius*, nn. spp. (Hook. Ic. Pl. 1840, vol. iii. t. 245); *Tridontium tasmannicum*, n. sp. (t. 248); *Stackhousia flava*, n. sp. (t. 269); *Boronia nana*, n. sp. (t. 270); *Stenopetalum incisifolium*, n. sp. (t. 276); *Baeckia thymifolia*, *B. prostrata*, *B. affinis*, nn. spp. (t. 284); *Myriophyllum variaefolium*, n. sp. (t. 289); *Goniocarpus serpyllifolius*, n. sp. (t. 290); *Claytonia australasica*, n. sp. (t. 293); *Calandrinia calyptrata*, n. sp. (t. 296); *Epilobium macranthum*, n. sp. (t. 297); *Baeckia leptocaulis*, n. sp. (t. 298); *Milligania cordifolia*, n. sp. (t. 299); *Caldasia argentea*, n. sp. (t. 300).

1841.

Xanthosia dissecta, n. sp. (Hook. Ic. Pl. 1841, vol. iv. t. 302); *Hydrocotyle cordifolia*, n. sp. (t. 303); *Didiscus humilis*, n. sp. (t. 304); *Meionectes Brownii*, n. sp. (t. 306); *Didiscus pilosus* (t. 307); *Leptospermum rupestre*, n. sp. (t. 308); *Baeckia micrantha* (t. 309); *Tillaea macrantha*, n. sp. (t. 310); *Goniocarpus vernicosus*, n. sp. (t. 311); *Hydrocotyle tripartita* (t. 312).

1842.

On the examination of some fossil wood from Macquarie Plains, Tasmania. (Tasmanian Journ. Nat. Sci. 1842, vol. i. p. 24.)

1843.

Notes on the Botany of H.M. discovery ships "Erebus" and "Terror," in the Antarctic Voyage; with some account of the Tussac Grass of the Falkland Islands. (By W. J. Hooker, from letters of J. D. H.) (Hook. Lond. Journ. Bot. 1843, vol. ii. pp. 247–329.) Reprint. London, 1843.

1844.

The Botany of the Antarctic Voyage of H.M. discovery ships "Erebus" and "Terror" in the years 1839–1843, under the command of Captain Sir James Clark Ross—

Part I. Flora antarctica. London, 1844–1847. 2 vols., xii. + 574 pp., 198 pl. 4to.

(Pp. 289–302 translated in Ann. Sci. Nat. ser. 3, Bot. 1846, vol. v. pp. 193–225, pl. 5–9.)

Part II. Flora Novae-Zelandiae. Vol. i., Flowering Plants. London, 1853–1855. xxxix. + 312 pp., pl. 1–70.—Vol. ii., Flowerless Plants. 1855. 378 pp., pl. 71–130. 4to.

Introductory Essay, pp. i.–xxxix. reprinted, London, 1853. (Analysis of the Introductory Essay, pp. ii.–xxxvi. by A. Gray in Amer. Journ. Sci. Arts, 1854, ser. 2, vol. xvii. pp. 241–252, 334–350.)

Part III. Flora Tasmaniae. Vol. i., Dicotyledones. London, 1855–1860. cxxviii. + 18 + 359 pp., pl. 1–100.—Vol. ii., Monocotyledones and Acotyledones. 1860. 422 pp., pl. 101–200. 4to.

Introductory Essay, pp. i.–cxxviii. reprinted, London, 1859. (Pp. i.–xxix., c.–cv. reprinted in Amer. Journ. Sci. Arts, 1860, vol. xxix. pp. 1–25, 305–326; pp. i.–xxvi. translated in Oesterr. Bot. Zeitschr. 1861, vol. xi. pp. 65–81, 118–128, 155–167.)

Some account of a new *Elaeodendron* from New Zealand. (Hook. Lond. Journ. Bot. 1844, vol. iii. pp. 228–230, pl. 8.)

Catalogue of the names of a Collection of Plants made by Mr. Wm. Stephenson, in New Zealand. (Hook. Lond. Journ. Bot. 1844, vol. iii. pp. 411–418.)

Hepaticae Antarcticae; being characters and brief descriptions of the Hepaticae discovered in the southern circumpolar regions during the voyage of H.M. discovery ships "Erebus" and "Terror." (By J. D. H. and T. Taylor.) (Hook. Lond. Journ. Bot. 1844, vol. iii. pp. 454–480.)

Notes on the Cider Tree (*Eucalyptus Gunnii*). (Hook. Lond. Journ. Bot. 1844, vol. iii. pp. 496–501.)

Musci Antarctici; being characters, with brief descriptions, of the new species of Mosses discovered during the voyage of H.M. discovery ships "Erebus" and "Terror" in the southern circumpolar regions, together with those of Tasmania and New Zealand. (By J. D. H. and W. Wilson.) (Hook. Lond. Journ Bot. 1844, vol. iii. pp. 533–556.)

Hepaticae Novae Zelandiae et Tasmaniae ; being characters and brief descriptions of the Hepaticae discovered in the Islands of New Zealand and Van Diemen's Land, during the voyage of H.M. discovery ships "Erebus" and "Terror," together with those collected by R. C. Gunn and W. Colenso. (By J. D. H. and T. Taylor.) (Hook. Lond. Journ. Bot. 1844, vol. iii. pp. 556–582.)

Lichenes Antarctici ; being characters and brief descriptions of the new Lichens discovered in the southern circumpolar regions, Van Diemen's Land, and New Zealand, during the voyage of H.M. discovery ships "Erebus" and "Terror." (By J. D. H. and T. Taylor.) (Hook. Lond. Journ. Bot. 1844, vol. iii. pp. 634–658.)

Lomaria Colensoi, n. sp. (Hook. Ic. Pl. 1844, vol. vii. t. 628); *Myrtus pedunculata*, n. sp. (t. 629); *Fagus fusca*, n. sp. (tt. 630, 631); *Callixene parviflora*, n. sp. (t. 632); *Loranthus Colensoi*, n. sp. (t. 633); *Ranunculus macropus*, n. sp. (t. 634); *Gentiana bellidifolia*, n. sp. (t. 635); *G. Grisebachii*, n. sp. (t. 636); *Fagus Solandri*, n. sp. (t. 639): *Veronica nivea*, n. sp. (t. 640); *V. diffusa*, n. sp. (t. 645); *Fagus Menziesii*, n. sp. (t. 652); *F. cliffortioides*, n. sp. (t. 673); *Stellaria decipiens*, n. sp. (t. 680); *Epilobium confertifolium* (t. 685); *Cardamine corymbosa* (t. 686.)

1845.

Hepaticae Antarcticae, supplementum ; or specific characters, with brief descriptions, of some additional species of the Hepaticae of the Antarctic regions, New Zealand, and Tasmania, together with a few from the Atlantic Islands and New Holland. (By J. D. H. and T. Taylor.) (Hook. Lond. Journ. Bot. 1845, vol. iv. pp. 79–97.)

On the Huon Pine, and on *Microcachrys*, a new genus of *Coniferae* from Tasmania ; together with remarks upon the geographical distribution of that order in the Southern Hemisphere. (Hook. Lond. Journ. Bot. 1845, vol. iv. pp. 137–157, pl. 6.)

Algae Antarcticae, being characters and descriptions of the hitherto unpublished species of Algae, discovered in Lord Auckland's Group, Campbell's Island, Kerguelen's Land, Falkland Islands, Cape Horn, and other circumpolar regions, during the voyage of H.M. discovery ships, "Erebus" and "Terror." (By J. D. H. and W. H. Harvey.) (Hook. Lond. Journ. Bot. 1845, vol. iv. pp. 249–276, 293–298.)

Algae Novae Zelandiae ; being a catalogue of all the species of Algae yet recorded as inhabiting the shores of New Zealand, with characters and brief descriptions of the new species discovered during the voyage of H.M. discovery ships "Erebus" and "Terror" ; and of others communicated to Sir W. Hooker by Dr. Sinclair, the Rev. W. Colenso, and M. Raoul. (By J. D. H. and W. H. Harvey.) (Hook. Lond. Journ. Bot. 1845, vol. iv. pp. 521–551 ; vol. vii. pp. 443–445.)

On *Fitchia*, a new genus of arborescent *Compositae* (Trib. *Cichoraceae*), from Elizabeth Island (lat. 26°, long. 125° W.), in the South Pacific. (Hook. Lond. Journ. Bot. 1845, vol. iv. pp. 640–643, pl. 23, 24.)

Note on some marine animals, brought up by deep-sea dredging, during the Antarctic Voyage of Captain Sir James C. Ross. (Ann. Nat. Hist. 1845, vol. xvi. pp. 238–239.)

Aralia polaris. (Hook. Ic. Pl. 1845, vol. viii. t. 747.)

1846.

Note on a fossil plant from the Fish River, South Africa. (Trans. Geol. Soc. 1846, vol. vii. p. 227.)

Description of *Pleuropetalum*, a new genus of *Portulaceae*, from the Galapagos Islands. (Hook. Lond. Journ. Bot. 1846, vol. v. pp. 108–109, pl. 2.)

Description of a new genus of *Compositae* [*Scleroleima*], and a new species of *Plantago* [*P. Gunnii*], from the mountains of Tasmania. (Hook. Lond. Journ. Bot. 1846, vol. v. pp. 444–447, pl. 13, 14.)

1847.

J. C. Ross, A voyage of discovery and research in the Southern and Antarctic Regions, during the years 1839–43, vol. i. pp. 83–87, 144–149, 158–163 ; vol. ii. pp. 5–8, 261–277, 288–302. London, 1847.

Florae Tasmaniae Spicilegium ; or Contributions towards a Flora of Van Diemen's Land. (Hook. Lond. Journ. Bot. 1847, vol. vi. pp. 106–125, 265–286, 461 [bis]–479 [bis].)

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II.—DECADES KEWENSES

Plantarum Novarum in Herbario Horti Regii Conservatarum.

DECADES LXIII.-LXIV.

621. **Berberis (Sinenses) Stapfiana**, *C. Schneider* [Berberidaceae]; affinis *B. subcaulialatae*, C. Schneider, sed ab ea differt foliis minoribus, fructibus ellipticis minoribusque; a *B. Wilsonae*, Hemsley, et *B. Fineti*, C. Schneider, ramulis glaberrimis diversa.

Frutex parvus, glaberrimus, ramosissimus; rami fructiferi nigro-purpurascentes vel nigrescentes, divaricati, plus minusve angulati; spinae normales, 3-fidae, graciles, acutissimae, brunnescentes, subtus distincte sulcatae, mediae ad 1·3 cm. longae, laterales vix minores. *Folia* decidua, crasse membranacea, ad 4–8-fasciculata, oblanceolata, apice acuta vel obtusa vel rotundata, sed semper mucronata, integerrima, margine leviter revoluta, supra viridia, subtus albescentia vel paullo pruinosa, distincte papillosa, utrinque distincte anguste reticulata, minora 7 : 2, majora ad 22 : 4–5 mm. magna, in petiolum brevissimum attenuata. *Inflorescentiae* quam folia majora breviores, fasciculato-racemosae, 4–7-florae, leviter pruinosae. *Pedicelli* 3–4 mm. longi, basi bracteis duobus late ovatis acutis 6 mm. longis instructi. *Flores* flavi, globosi, 3–4 mm. in diametro. *Sepala* exteriora late ovata, interiora fere rotunda. *Petala* obovata, apice rotundata, basi breviter unguiculata, glandulifera, sepalis interioribus vix breviora. *Stamina* petalis breviora, apice obtusa. *Ovarium* staminibus aequilongum, ovulis 3 sessilibus instructum. *Fructus* elliptici, intense carmineo-colorati, leviter pruinosi, 5–6 mm. longi et 4–4·5 mm. crassi, stylo minimo sed distincto; semina 2, pallide flava.

China. Grown at Kew from a plant received from Les Barres, *Vilmorin*, No. 4039; from seeds from the Arnold Arboretum, Jamaica Plains, Mass., *Wilson*, 1284 (seed number); and from Messrs. Veitch & Sons, *Wilson*, 1560.

The above description was drawn up by Dr. Schneider from a specimen of *Vilmorin*, 4039, sent to him from Kew, where it was grown.

This species seems to be a very distinct one. It is nearly related to some other small Chinese *Berberis* of the same external appearance, and it looks very like *B. subcaulialata*, C. Schn., but this species has somewhat larger leaves and globose fruits. *B. Wilsonae*, *B. aggregata* and *B. Fineti* differ from the new one by distinctly puberulous branches and in some other respects. *B. elegans*, C. Schn., recedes by its stalked corymbs and different reticulated leaves.

622. **Decaschistia rufa**, *Craib* [Malvaceae-Hibisceae]; *D. crotonifoliae*, Wight et Arn., affinis sed indumento ramulorum rufo foliorum pagina inferiore longiore, bracteolis majoribus, seminibus vix glabris recedit.

Ramuli apice dense rufo-hirsuti, dein pallidiores, minutissime tomentelli. *Folia* subrotundata, ovato-elliptica, elliptica vel oblongo-elliptica, apice breviter acuminata, acuta vel subobtusa,

basi rotundata, subcordata, 3–10 cm. longa, 1·5–7 cm. lata, coriacea, supra breviter molliter stellato-pubescentia, subtus densius fulvo-pubescentia, margine dentata, crenato-serrata vel denticulata, e basi 5-nervia duobus inferioribus minus conspicuis, nervis secondariis (e costa ortis) utrinque circiter 4 supra subconspicuis subtus prominentibus, nervis transversis supra plerumque leviter impressis subtus prominulis; petioli 0·5–3 cm. longi, indumento ut in ramulis; stipulae deciduae. *Pedicelli* in fructu validi, ad 2·4 cm. longi, indumento ut in ramulis. *Bracteolae* basi plus minusve connatae, acuminatae, subacutae, ad 1 cm. longae et 4 mm. latae, indumento extra ut in pedicellis, intra parcius appresse pubescentes. *Calyx* infructescens 1·5 cm. longus, lobis late triangularibus acuminatis obtusiusculis ad 1 cm. longis 0·6 cm. latis conspicue nervatis, extra indumento ut in ramulis, intra superne tenuiter appresse pubescens. *Corolla* circiter 6 cm. longa. *Tubus* staminalis circiter 2 cm. longus, filamentis ad 2 mm. longis glabris. *Capsula* calycem vix aequans, dense hirsuta; semina fusca, ad 5 mm. longa, parcissime brunneo-pilosula.—*D. crotonifolia*, Masters in Fl. Brit. Ind., vol. i. p. 332 in part, vix Wight et Arn.

India. Pen. Ind. Or.: without precise locality, *Herb. Rottler*, et *Wall. Cat.* 1901 in part. ? Madras, Tiruvallur, Kumbākkam Drug, *Cleghorn in Herb. Foulkes.*

623. **Rubus conduplicatus**, *Duthie* [Rosaceae-Rubeae]; affinis *R. triantho*, Focke, sed foliorum facie inferiore pallide viridi, non alba, floribus minoribus, aculeis caulium vetustiorum robustioribus et magis curvatis differt; etiam *R. inciso*, Thunb. comparandus, sed foliis ovato-lanceolatis, paniculis 3–4-floris, haud unifloris, recedit.

Frutex scandens, eglandulosus, glaber, calycis loborum facie interiore excepta. *Caules* et ramuli primarii nigro-purpurei, glabri et saepius glaucescentes, juniore rubri, aculeis plerumque curvatis. *Folia* simplicia, petiolata; lamina 3·8–7 cm. longa et 2·5–5 cm. lata, ovato-lanceolata, acuminata, interdum subtrilobata, basi cordata, rarius rotundata, subtus pallide viridia, marginibus inaequaliter inciso-serratis, costa et nervis primariis subtus prominentibus rubro coloratis sparse aculeatis. *Flores* in paniculas laxas 3–4-floras terminales dispositi, 1·3–1·9 mm. diametro, pedicellis gracilibus, 1·3–2·5 cm. longis; bracteae anguste lanceolatae, deciduae. *Calyx* extra glaber, nigro-purpureus, tubo hemispherico, lobis erectis tubo longioribus triangularibus cuspidatis et apice reflexis intus albo-sericeis. *Corolla* alba; petala 6–12 mm. longa, deflexa, conduplicata, marginibus undulatis. *Ovarium* glabrum, stylo ad basim sericeo, receptaculo pubescenti. *Carpella* matura glabra, putamine reticulato.

Central China. Mountains of N.W. Hupeh, *E. H. Wilson*, 904.

624. **Rubus Wilsonii**, *Duthie* [Rosaceae-Rubeae]; species ex affinitate *R. inoperti*, Focke, a quo foliis 1–2-jugis et calyce extra brunneo-purpureo recedit.

Frutex scandens. *Caules* teretiusculi, spinosissimi, brunneo-purpurei, glaucescentes; ramuli quadrangulares, rubro-purpurei, glauci, angulis praesertim infra nodos subalatis. *Folia* pinnatim 1–2-juga, usque ad 15 cm. longa, petiolis rhachique aculeis paucis

gracilibus armatis; foliola membranacea, grosse duplicato-serrata, supra rugosa, saturate viridia, glabra, subtus pallidiora, basi plus minusve cordata, costa subtus sparse aculeata, nervis primariis 6–8-jugis sursum paullum arcuatis; foliola lateralia subsessilia, 4–5 cm. longa, inaequaliter ovata, acuta vel acuminata; foliolum terminale late ovatum vel suborbiculare, supra medium interdum leviter trilobatum, basi rotundata vel subcordata; stipulae oblique lanceolatae, acuminatae, glabrae. *Flores* in fasciculos axillares et terminales breves paniculatos dispositi; fasciculi terminales 4–5-flori, axillares 2–3-flori; pedicelli 0·6–1·3 cm. longi, glabri, saepe paucis parvis aculeis armati; bracteae 3–6 mm. longae, cymbiformes, glabrae. *Calyx* extra valde brunneo-purpureus, glaber, intus dense albo-sericeus; lobi ovati, apice cuspidati, reflexi, marginibus obtectis interiorum loborum etiam albo-sericeis. *Petala* 8 mm. longa et lata, purpurea, marginibus erosis. *Carpella* stylique pilosi.

Central China. Mountains of Hupeh, *E. H. Wilson.*

The above description was prepared from living specimens supplied by Messrs. J. Veitch & Sons, which had been raised by them from seed sent to them by Mr. Wilson from China in 1901.

625. **Cyananthus cordifolius**, *Duthie* [Campanulaceae-Campanuleae]; affinis *C. pedunculato*, C. B. Clarke, sed foliis basi cordatis, marginibus crenatis.

Herba perennis. *Caules* 14–27 cm. longi, sparse pilosi vel glabri, basi prostrati et interdum ramulis sterilibus ex axillis inferioribus productis. *Folia* sessilia, 1–1·5 longa et ·8–·9 cm. lata, triangulari-ovata, obtusa vel subacuta, supra glabra vel sparse pilosa, infra constanter albo-pilosa, basi cordata, marginibus crenatis revolutis; folia ramulorum sterilium multo minora, elliptico-ovalia, subintegra, basi rotundata, rarius obscure cordata. *Flores* pedunculati, 5-meri, pedunculis 1–1·5 cm. longis nigro-villosis. *Calyx* 1·5–2 cm. longus, fere ad medium divisus, pilis nigris longis hirsutus; lobi lanceolati, acuti, apice saepius reflexi. *Corolla* coerulea, glabra, 2·5–3 cm. longa, ad mediam divisa; lobi apice rotundati.

Himalaya. Western Nepal: Nampa Gádh, circa 3350 m., *Duthie*, 5730. N. Kumaon: Kutti Yangti Valley, circa 3960 m., *Duthie*, 3114.

626. **Syringa** (§Vulgares) **Julianae**, *C. Schneider*, Ill. Handb. Laubholzk., vol. ii. p. 777, Dec. 1911, sine diag. lat. [Oleaceae]; affinis *S. pubescenti*, Turcz., sed foliis minoribus etiam supra puberulis brevius petiolatis, floribus minoribus, antheris paulo infra faucem corollae tubo insertis differt.

Frutex ut videtur breviter denseque ramosus. *Ramuli* usque annum secundum plus minusve pubescentes, deinde glabri, cinerascentes. *Folia* ramulorum floriferorum ovalia, basi apiceque acuta vel subacuta, supra viridia, plus minusve puberula, subtus pallidiora, distinctius (praesertim ad nervos) pubescentia, 2·5–4·3 cm. longa et 1–2·3 cm. lata; petioli 3–5 mm. longi, puberuli. *Inflorescentiae* satis parvae, ad 6 cm. longae, modo ramulorum pubescentes, erectae; pedicelli puberuli, brevissimi. *Flores* albo-rosei; tubus circa 6 mm. longus; laciniae corollae 2–2·5 mm. longae, subacutae, explanatae; calyx glaber, violaceus, laciniae brevissimae, sed satis distinctae, acutae. *Antherae* violaceae, in sicco nigrescentes. *Fructus* ignoti.

Central China. Introduced by Mr. E. H. Wilson.

This is a very distinct species, a member of the section *Vulgares* subsect. *pubescentes*, closely allied to *S. pubescens* by the dark-red—not yellow—anthers.

627. **Zschokkea Foxii**, *Stapf* [Apocynaceae-Carisseae]; affinis *Z. utili*, Hemsl., sed foliis majoribus, nervis magis numerosis supra haud impressis, corollae segmentis oblongis duplo longioribus, antheris longioribus differt.

Arbor alta, glaberrima, ramulis florentibus fuscis apicem versus leviter compressis. *Folia* elliptica, basi breviter acuta, apice breviter acuminata acumine obtusiusculo, 4·5–7 cm. longa, 2·2–3·5 cm. lata, coriacea, exsiccando supra brunnea vel fusca, infra ochreo-brunnescentia, et minute nigro-punctata, costa supra leviter canaliculata infra prominente, nervis utrinque 15–17 tenuibus margines versus arcuatim connectis supra obscure prominulis; petiolus 8–9 mm. longus, latiusculus, canaliculatus. *Flores* albi, in corymbos axillares breviter pedunculatos multifloros dispositi; pedunculi ad 4 vel 5 mm. longi; bracteae ovatae, acutae, 1–2 mm. longae; pedicelli ad 3 vel 4 mm. longi, praeter alares 2-bracteolati, bracteolis 1 mm. longis ovatis. *Calyx* 2·5 mm. altus; segmenta elliptico-ovata, obtusa, minute ciliolata. *Corolla* alba, 15 mm. longa, tubo cylindrico ima basi et supra medium paulo ampliata, lobis oblongis 2·5 mm. longis. *Antherae* subulato-lineares, tenuiter acuminatae, fere 5 mm. longae, cruribus basalibus 1 mm. longis. *Stylus* cum stigmate 5 mm. longus, stigmatis cruribus tenuiter subulatis fere 2 mm. longis. *Fructus* ignotus.

Peru. Putumayo Territory: Entre Rios and Sabana (about 72° W. Long., 1° S. Lat.), *Fox*, 31.

Vernacular name: "Minyadotana."

This tree, according to Mr. Fox, yields a latex which is used for mixing with *Hevea* and *Castilloa* rubber.

628. **Strychnos similis**, *A. W. Hill* [Loganiaceae]; species *S. multiflorae*, Benth. et *S. lanatae*, *A. W. Hill*, affinis sed ab ambabus antheris fusco-viridibus basi barbatis et a *S. multiflora* stylo basi hirsuto differt.

Folia anguste elongata-elliptica, acuminata, basi cuneata, 5-nervia, conspicue triplinervia, 12–15 cm. longa, 3·5–4 cm. lata, subcoriacea; petiolus circiter 1 cm. longus. *Inflorescentia* axillaris, paniculata, multiflora, pedunculis plus minusve glabris pedicellis fusco-tomentosis; bracteis ovatis marginibus breviter ciliatis. *Flores* in cymas trifloras dispositi, pedicellis circiter 3 mm. longis. *Calyx* 1 mm. longus, segmentis ovatis obtusis marginibus ciliatis. *Corolla* 5·5 mm. longa, lobis 2·75 mm. longis anguste ovato-lanceolatis acutis inferne et corollae fauce hirsutis. *Stamina* filamentis 0·75 mm. longis; antherae fusco-virides basi barbatae. *Ovarium* globosum, 8 mm. diametro, hirsutum; stylus 3·5 mm. longus, basi hirsutus. *Fructus* ignotus.

Philippine Islands, Mindanao: Province of Surigao; Hinatuan (E. coast), *C. V. Piper*, 504.

The specimen on which this species has been founded was sent to Kew by Mr. E. D. Merrill and arrived shortly after the paper

on *Strychnos Ignatii*, etc., was published (*K. B.* 1911, pp. 281–303). This new species closely resembles *S. multiflora* and its allies *S. dubia* and *S. lanata*, but differs especially in its bearded, dark green anthers. It was collected on the E. coast of Mindanao, a locality from which we have no previous collections.

629. **Paracaryum trinervium**, *Duthie* [Boraginaceae-Cynoglosseae]; affinis *P. himalayensi*, C. B. Clarke, sed foliis conspicue trinerviis, floribus multo majoribus et calycis lobis latioribus differt.

Herba perennis. *Caulis* erectus, ramosus, superne sericeo-pilous. *Folia* (caulina) sessilia, 5–8 cm. longa et 0·7–1·3 cm. lata, lineari-lanceolata, acuta, valde trinervia, dense et molliter pilosa, demum pilis rigidis e tuberculo ortis asperrima. *Racemi* fructiferi elongati, asperi, pedicellis calyce brevioribus. *Calyx* 3·5 mm. longus, prope ad basim divisus, dense canescenti-pilosus, lobis ovatis obtusis vel subacutis intus glabratis. *Corolla* rotata, coerulea, 6 mm. diametro, tubo 2 mm. longo, lobis late obovatis, ad apicem rotundatis, integris, squamis late reniformibus. *Antherae* inclusae, 1 mm. longae, oblongo-ovales. *Stylus* 1 mm. longus. *Nuculae* ovatae, 4–5 mm. longae, marginibus dentatis, dentibus glochidiatis; disco aculeato.

Eastern Tibet, Lhasa, circa 3650 m., *Waddell.*

630. **Eritrichium densiflorum**, *Duthie* [Boraginaceae-Eritrichieae]: ex affinitate *E. Monroi*, C. B. Clarke, sed habitu robustiore, ramis suberectis, nuculis transverse rugosis dorsoque punctato-excavatis differt.

Herba perennis, minuta, tota canescenti-pilosa vel hispida. *Caules* ramosi, rigidi, 5–7 mm. longi, adpresse pilosi. *Folia* sessilia, saepe basi amplexicaulia, usque ad 15 mm. longa, ovata, obovato-oblonga vel oblanceolata, obtusa vel subacuta, utrinque adpresse pilosa, demum crassa et setosa, setis tuberculo insidentibus. *Flores* numerosi, in cymata racemosa dense compacti, pedicellis brevissimis, superioribus ebracteatis, bracteis foliaceis. *Calyx* 3 mm. longus, 5-partitus, in fructu parum auctus, lobis linearibus, extra setis rigidis indutis. *Corolla* 2 mm. longa et lata, tubo calyce longiore albo vel pallide flavo, lobis obovatis coeruleis vel albis apice rotundatis, squamis exsertis subquadratis emarginatis. *Filamenta* ad mediam corollam affixa, antheris dimidio breviora. *Nuculae* ovatae, dorso punctato-excavatae, minute hispidae, marginibus integris.

Eastern Tibet. Yan Dho Cho, *Younghusband*, 1551; Sangpo Valley, *Walton*, 1550; Gyangtze, *Walton*, 1552, 1553; Pembu La, *Walton*, 1547; Lhasa, circa 3650 m., *King's collector*, 276, 1548, 1549.

E. densiflorum was also collected by Sir Joseph Hooker in Sikkim at elevations between 3960 and 4360 m. This is the *Eritrichium* No. 13 (in part) of Hook. f. and Thoms. Kew Distrib. It has also more recently been obtained by Strachey & Duthie in N. Kumaon. *E. Monroi* is widely distributed along the inner ranges of the Himalaya, and it is quite possible that further careful study of the ample material in the Kew Herbarium may necessitate the recognition of other species quite as distinct as the subject of this notice.

631. **Microula pustulata**, *Duthie* [Boraginaceae-Eritrichieae]; sub *Eritrichio pustulato*, C. B. Clarke in Fl. Brit. Ind. iv. 164;

habitu ad *M. sikkimensem*, Hemsl., accedit, sed statura minore, caulibus basi procumbentibus, inflorescentia omnino dissimili, floribus minoribus recedit.

Descr. emend. Herba perennis, rhizomate verticali sublignoso. *Caules* numerosi, adscendentes vel prostrati, adpresse pilosi vel saepe patule setulosi. *Folia* 1–4 cm. longa, elliptico-obovata vel spathulata, utrinque canescenti-strigosa, inferiora in petiolum attenuata. *Racemi* pauciflori, terminales vel laterales, bracteati. *Flores* minuti, inferiores saepius solitarii et suboppositifolii; pedicellii calycem aequantes, fructiferi elongati arcuati. *Calyx* dense sericeo-pilosus, 2·5 mm. longus, post anthesim parum auctus, lobis 2 mm. longis triangulari-lanceolatis obtusis. *Corolla* coerulea, 3 mm. longa; lobi 1 mm. longi, oblongi, rotundati, squamis reniformibus. *Antherae* sessiles, inclusae. *Nuculae* 2 mm. longae, rhomboideo-ovatae, tuberculatae, hispidulae, tuberculis setis minutis coronatis, dorso supra medium foveola ovata munitae.

Eastern Tibet. Chumbi; Syampoo, *King's collector*, 126 (1884).

This plant, which was originally discovered by Sir Joseph Hooker in Sikkim at elevations between 4000 and 4500 m., is the *Eritrichium* No. 14 of Hook. f. and Thoms. Kew Distrib., and the type of *E. pustulatum*, C. B. Clarke in Fl. Brit. Ind. l.c. Additional material was obtained by the present writer in 1884 on the mountains of N. Kumaon at elevations of about 4360 m. The nutlets are very similar to those of *M. sikkimensis*, having the same characteristic tubercles tipped with minute bristles.

632. **Microula Younghusbandii**, *Duthie* [Boraginaceae-Eritrichieae]; affinis *M. tibeticae*, Maxim., sed omnino minor et calycis lobis longioribus et suberectis, nuculis laevibus, foveola lineari subapicali recedens.

Herba exigua, perennis, subacaulescens, tota appresse pilosa. *Rhizoma* verticale, 3–6 cm. longum, crassum. *Folia* utrinque canescenti-pilosa, demum setis paucis tuberculo insidentibus munita; radicalia 1–1·5 cm. longa, lineari-lanceolata vel spathulata, obtusa vel subacuta, basi in petiolum attenuata; folia caulina breviora et ex proportione latiora, elliptica vel oblanceolata. *Flores* coerulei vel albi, in cymata densa bracteata dispositi; bracteae (folia floralia) floribus longiores, oblongae vel obovatae, obtusae; pedicelli calyce breviores. *Calyx* circa 2 mm. longus, prope ad basin divisus, extra pilosus, lobis lanceolatis acuminatis intus glabratis. *Corolla* rotata, 3 mm. diametro; tubus calyce paulo brevior, lobis obovatis; squamae exsertae, subreniformes. *Antherae* infra squamas inclusae. *Stylus* inclusus. *Nuculae* laeves, ad dorsum supra medium foveola lineari crasse marginata instructae.

Eastern Tibet. Gyamptsoma, near the source of the Tista, at about 4850 m., *Younghusband*, 1554.

633. **Onosma longiflorum**, *Duthie* [Boraginaceae-Lithospermeae]; affinis *O. Hookeri*, C. B. Clarke, sed floribus multo longioribus, filamentis non dilatatis, nuculis tuberculatis differt.

Herba perennis, basi suffrutescens. *Caules* erecti vel adscendentes, subangulati, sulcati, puberuli et setis patentibus rigidis albis induti. *Folia* subcoriacea, 4–7 cm. longa et 5–7 mm. lata, utrinque minute

et dense puberula, supra omnino et subtus ad costam valde setosa ; folia inferiora oblanceolata, obtusa vel subacuta, in petiolum attenuata ; superiora sessilia, lineari-lanceolata, acuta. *Racemi* terminales, divaricati ; bracteae calyce breviores, anguste lineari-lanceolatae, acuminatae, setulosae. *Calyx* 15 mm. longus, prope ad basin partitus, laciniis lanceolatis acuminatis extra dense setosis intus glabratis. *Corolla* coeruleo-purpurea, 3 cm. longa, sericeo-velutina, tubuloso-infundibuliformis ad basin attenuata, lobis brevibus rotundatis reflexis. *Filamenta* haud dilatata. *Nuculae* triquetrae, apice abrupte acutae, non nitidae, dorso tuberculatae.

Eastern Tibet. Gyantze, *Walton*, 57 and 1561 ; Lhasa, circa 3650 m., *Waddell*.

634. **Onosma Waltoni**, *Duthie* [Boraginaceae-Lithospermeae] ; ex affinitate *O. Waddellii*, Duthie, sed herba robustior et magis erecta, floribus majoribus et cymis in fructu paullo elongatis.

Herba perennis, basi suffrutescens, tota setis tuberculo insidentibus asperrima. *Caules* robusti, suberecti, minute puberuli, etiam pilis rigidis deflexis intermixtis. *Folia* sessilia, semi-amplexicaulia, 2–4 cm. longa et 6–8 mm. lata, oblongo-lanceolata, apice obtusata, obscure mucronata, utrinque dense puberula, pagina superiore et costa infra valde setosis. *Cymata* sub anthesin pseudo-capitata, in fructu paulo elongata, foliis floralibus ovato-lanceolatis obtusis. *Calyx* 5–8 mm. longus, prope ad basin divisus, extra dense setosus, intus glaber, laciniis lineari-lanceolatis demum accrescentibus. *Corolla* coerulea, 1–3 cm. longa, tubuloso-campanulata ; lobi depresse triangulares, marginibus reflexis, apice calloso. *Filamenta* infra medium corollam connata ; antherae parum exsertae. *Stylus* in fructu longe exsertus. *Nuculae* 3 mm. longae, obscure tuberculatae, nitidae.

Eastern Tibet. Gyantze, *Walton*, 60, 1560 & 1562.

635. **O. Waddellii**, *Duthie* [Boraginaceae-Lithospermeae] ; affinis *O. Waltoni*, Duthie, sed caulibus gracilioribus et decumbentibus, cymis laxis et in fructu elongatis, filamentorum parte dilatata libera, nuculis haud nitidis differt.

Herba perennis. *Caules* decumbentes, quadrangulares, sulcati, patule setosi. *Folia* 1·5–3·5 longa et 4–9 mm. lata, lineari-oblonga vel oblanceolata, obtusa vel subacata, utrinque minute hispida, supra etiam setis longis tuberculo insidentibus instructa. *Cymata* brevia, pseudo-capitata, in fructu elongata ; bracteae inferiores foliaceae, supremae lineares, calyce breviores. *Calyx* 4 mm. longus, prope ad basin divisus ; laciniae anguste lineari-lanceolatae, extra dense canescenti-pilosae. *Corolla* coerulea, campanulata, 1 cm. longa, ad basin flavescens, lobis parvis triangulatis, apice reflexo calloso. *Filamenta* 5 mm. longa, sursum ad mediam coerollam dilatata, parte dilatata libera ; antherae longe exsertae, atro-coeruleae. *Stylus* post anthesin elongatus. *Nuculae* 3 mm. longae, ovoideae, grosse tuberculatae, haud nitidae.

Eastern Tibet. Lhasa, circa 3650 m., *Waddell* ; Sangpo Valley, circa 4600 m., *Walton* ; North of Phári, *King's Collector*, (363 & 365 of Herb. Calc.).

636. **Columnea** (**Eucolumnea**) **Fendleri**, *Sprague* [Gesneriaceae] ; affinis *C. scandenti*, Linn., a qua calycis segmentis magis attenuatis

inferne utrinque longe unidentatis, corollae tubo longiore, corollae limbo breviore recedit.

Caulis obtuse tetragonus, in sicco vix 5 mm. crassus. *Folia* elliptico-oblonga, apice obtusa, basi inaequalia, obtusa, 2·5–4·5 cm. longa, 1–1·5 cm. lata, rubro-marginata, supra appresse hirsutula, subtus grosse sericco-hirsuta ; nervi laterales utrinque 4, obliqui ; petioli 3–5 mm. longi. *Pedicelli* 1·3–1·7 cm. longi. *Calycis segmenta* erecta, basi circiter 0·5 mm. connata, circiter 3 mm. supra basin utrinque patule unidentata dentibus linearibus 2–2·5 mm. longis, in toto 1·5 cm. longa, ad insertionem dentium 2 mm. lata, abhinc deorsum leviter angustata, sursum sensim attenuata, trinervia, extra conspicue, intus brevius parcius hirsuta. *Corolla* circiter 6·5 cm. longa ; tubus gracilis, circiter 4 cm. longus, sursum paulo ampliatus ; limbus 2·3–2·5 cm. longus ; lobus anticus oblongo-lanceolatus, 1·2 cm. longus, 3·5 mm. latus ; lobi laterales circiter 1 cm. galeae adnati marginibus superioribus circiter 8 mm. longis ; galeae pars libera 1·5 cm. longa, 1·1–1·2 cm. lata, apice cuneato-rotundata, apiculata. *Vagina staminalis* medio 7 mm., lateribus 6 mm. longa, corollae tubo 3 mm. adnata ; antherae 2 mm. longae. *Disci glandula* unica, 1·6 mm. longa. *Ovarium* ovoideum, 2·75 mm. longum, glabrum ; stylus inferne glaber, superne pilosus.

Venezuela. Near Colonia Tovar, *Fendler*, 2031.

Hanstein in Linnaea, vol. xxxiv. p. 104, included under *C. scandens*, Linn., a specimen in the Berlin herberium collected at Puerto Cabello, Venezuela, by Karsten. According to Urban, Symbolae Antillanae, vol. ii. p. 360, Karsten's specimen represents a distinct species or variety. Hanstein stated that the calyx segments were more evidently toothed than in typical *C. scandens*, and Urban mentions that the corolla is long-attenuate below. It is therefore probable that Karsten's specimen is referable to *C. Fendleri*.

637. **Columnea (Eucolumnea) Tuerckheimii**, *Sprague* [Gesneriaceae] ; affinis *C. gloriosae*, Sprague, a qua caulibus gracilibus, foliis pro rata minus obliquis, calyce extra sparsius piloso loborum marginibus remote denticulatis haud reflexis, corolla sursum minus expansa galea angustiore, antheris brevioribus recedit.

Planta in arboribus epiphytica ramis pendulis. *Ramuli* graciles, in sicco 1·2 mm. diametro 30 cm. infra apicem, angulati, costati, pilis patentibus pluricellularibus acutis hirsuti. *Folia* leviter anisophylla, juvenilia marginibus reflexis, adulta plana, elliptico-oblonga vel ovato-oblonga, apice acuta, basi rotundata vel subcordata, 2·5–4 cm. longa, 1·3–1·9 cm. lata, exsiccando membranacea, supra hirsuta, subtus nervis hirsutis ceterum parce inconspicue pilosula ; nervi laterales utrinque 4, leviter curvati tantum, supra vix visi, subtus prominuli ; petioli 2–4 mm. longi. *Pedicelli* circiter 1 cm. longi, hirsuti. *Calycis segmenta* breviter late unguiculata, patentia, ovato-oblonga, ungue incluso 1·2 cm. longa, 6–6·5 mm. lata, remote denticulata denticulis utrinque 2–3 infimis 0·8–1·3 mm. longis superioribus minoribus, supra longe dense subtus parce hirsuta. *Corolla* 6·2–6·5 cm. longa, coccinea ventre luteo, extra parciuscule villosa ; tubus circiter 2·5 cm. longus ; lobus anticus oblongo-linearis vel anguste oblongus, 2–3 cm. longus, 4–6·5 mm. latus ; lobi laterales 2·4–2·9 cm. galeae adnati ; galeae pars libera 1·3–1·4 cm. longa, 1·9–2·2 cm. lata, subtruncata. *Antherae* 2–2·3 mm. longae.

Disci glandula unica, e basi 1 mm. lata oblonga, 1·5 mm. longa, superne 0·4 mm. lata, retusa. *Ovarium* 3 mm. longum, dense appresse villosum villis erectis.—*Columnea microcalyx*, Donnell Smith, Enum. Pl. Guatem. vol. vi. p. 30, non Hanst.

Guatemala. Department of Alta Verapaz: Cubilquitz, 350 m., *Tuerckheim in Donnell Smith*, 7640.

In the description of *C. gloriosa* the length of the anthers was omitted: they are 3 mm. long.

638. **Incarvillea Wilsonii**, *Sprague* [Bignoniaceae]; affinis *I. Beresowskii*, Batalin, a qua pedicellis longioribus bracteas excedentibus, calyce majore, corollae limbo magno recedit.

Herba 1–2 m. alta, caule ramoso folioso, primo visu glabro, revera minute parcissime glanduloso. *Folia* radicalia (vel caulina inferiora?) longipetiolata, in toto circiter 40 cm. longa, pinnatipartita, rhachi anguste alata late sulcata supra minute densiuscule subtus parce glanduloso-pilosa, segmentis suboppositis 5–6-jugis lanceolato-oblongis apice acutis basi inaequilateris obtusis 5·5–8·5 cm. longis 2–3 cm. latis crenato-serratis utrinque minute parce glandulosis; petioli circiter 15 cm. longi; folia superiora similia, minora, segmentis circiter 3-jugis. *Racemi* terminales, multiflori (fide *Wilson*), et axillares vel ramulos axillares foliatos terminantes, internodiis sub anthesi usque ad 4 cm. longis; bracteae 3–8 mm. longae; pedicelli circiter 1 cm. longi, bracteis saepius duplo raro vix longiores, satis glandulosi. *Calyx* campanulatus, quinquecostatus, in toto 1·5–2 cm. longus, extra minute parce glandulosus; lobi late deltoidei, cuspidati, 4–6 mm. longi, apice uncinati. *Corolla* carmineo-rubra; tubus 4·5 cm. longus; limbus 5–5·5 cm. diametro densiuscule minute nigrescenti-punctatus. *Capsula* subacinaciformis, compresso-tetragona, 8–10 cm. longa, 11–12 mm. lata, circiter 7 mm. crassa, in apicem anguste truncatum breviter acuminata, a medio deorsum angustata, utrinque superne plana, inferne convexa; valvae fuscae, sublignosae; septum albidum, nitidulum, cicatricibus seminum utrinque medio septi triseriatis superne et inferne uniseriatis. *Semina* lenticularia, alata, cum ala 5–5·5 mm. diametro, sine ala 3 mm. diametro, superficie altera glabra, altera dense furfuraceo-pilosa; tegmen basi et apice testae affixum, in aqua membranaceum, in sicco tenuiter pergamentaceum. *Embryo* suborbicularis, 2·75 mm. diametro; cotyledones apice retusae, basi anguste cordatae, radicula vix exserta.

China. Western Szechuan: Hsao Chin Ho valley; near Monkong Ting, 2100–2400 m., *Wilson*, 3058.

639. **Amorphophallus Kerrii**, *N. E. Brown* [Aroideae-Pythonicae]; affinis *A. chlorospathae*, Kurz, sed folii segmentis lanceolatis quadruplo latioribus, spadice breviore et antheris albis differt.

Herba tuberosa, perennis. *Folium* solitarium, erectum, glabrum; petiolus 1 m. longus, viridis, albido-viridi-maculatus; lamina trisecta, ramis unifurcatis pinnatisectis; segmenta inferiora 5–7·5 cm. longa, 3–5·5 cm. lata, elliptica vel lanceolata; segmenta ultima 15–21·5 cm. longa, 5·5–7 cm. lata, lanceolata, acuta, basi in alam 4–8 mm. latam decurrentia. *Pedunculus* 25 cm. longus, 1 cm. crassus, olivaceo-brunneus, ocellis albido-viridibus maculatus. *Spatha* erecta, 15–18 cm. longa, 5 cm. lata, lanceolata, concava, apice leviter procurva, acuta, basi breviter convoluta, marginibus

haud undulatis, viridis, ocellis albido-viridibus maculata. *Spadix* spatha multo brevior, stipitata; pars feminea 1·5–2·5 cm. longa, 1·5 cm. crassa, cylindrica, viridis; ovarium globosum, in stylum 1·5 mm. longum contractum, stigmate punctiformi; pars mascula 1·5–2·5 cm. longa, 1·2–2·3 cm. crassa, cylindrica vel ellipsoidea, alba; appendix 3·8-4 cm. longa, 1·6–2·5 cm. crassa, subcylindrica vel obtuse trigono-ovoidea, laevis, lacteo-alba vel pallide luteo-viridis.

Siam. Collected in the Chiengmai District by *Dr. A. F. G. Kerr*, and sent to the Trinity College Botanic Garden, Dublin, where it flowered in March, 1910, and March, 1911, the leaf appearing in the following May.

No dried specimens of this species have yet been received from Dr. Kerr, so that it may be a somewhat rare or very local plant.

640. **Sciaphila australasica**, *Hemsl.* [Triuridaceae]; species perianthii lobis inappendiculatis.

Herba perennis, monoica vel dioica, saprophytica, aphylla, praeter radices pilosas glaberrima. *Caules* gracillimi, erecti, 8–23 cm. alti, simplices vel pauciramosi, ramis strictissimis, basi radices pilosas simplices vel perraro pauciramosas 2–5 cm. longas novellas sursum ordinatim emittentes, infra medium nudi vel squamis paucis minutis instructi. *Flores* racemosi, minuti, unisexuales, saepius dioici, raro monoici, si monoici superiores masculi; bracteae lanceolatae, 2–3 mm. longae, acutissimae, persistentes; pedicelli capillares, 0·5–2 cm. longi. *Perianthium florum* ♂ alte 5-lobum (an semper?); lobi ovato-lanceolati, circiter 0·75 mm. longi, obtusi, inappendiculati, incurvi. *Stamina* 3, subsessilia; antherae rima transversa dehiscentes. *Perianthium florum* ♀ saepius 6-lobum; lobi lanceolati, circiter 1 mm. longi, obtusi, inappendiculati, demum recurvi. *Carpella* numerosa; stylus supra carpelli medium lateralis, ventralis, filiformis, 2–3 mm. longus. *Carpella matura*, ut videtur, carnosa, globoso-obconica, 1–1·25 mm. longa, laevia, monosperma. *Semen* fusiforme, 0·75–1 mm. longum, utrinque obtusum; testa longitudinaliter subtiliter striata. *Embryo* mihi ignotus.

Australia. Queensland: Bellenden Ker Hills, at about 1000 m., *K. Domin.*

This is apparently the only member of the family hitherto discovered in Australia. It was growing in a dense mass of fine foreign roots, from which it was with difficulty extricated intact.

Some of the seeds were occupied by a solitary larva.

III.—A DISEASE OF SWEET PEAS, ASTERS, AND OTHER PLANTS.*

(*Thielavia basicola*, Zopf.)

(With Plate.)

G. Massee.

A disease attacking asters, sweet peas and various other cultivated plants, more especially during the seedling stage

* This article was printed in November, 1911, but had to be held over to this number owing to lack of space in the *Bulletin* for last year.

caused by a minute parasitic fungus, *Thielavia basicola*, Zopf, has become so prevalent during recent years, that in some localities their cultivation has been practically abandoned. The receipt at Kew of a considerable amount of diseased material in a condition favourable for investigation, has led to the discovery of the cause of the disease and also of measures whereby the danger can be prevented.

Morphology, &c.

The several very dissimilar forms constituting the life-cycle of *Thielavia basicola*, Zopf, has led to much complication and synonymy.

The mycelium first produced as the result of infection, permeates the tissues and remains slender and colourless. As a rule the host shows decided signs of injury, or is killed outright before the fungus commences to produce its fruit on the surface of the injured portions. When this stage has been reached, if conditions are favourable, branches of the mycelium grow outwards and cover the surface of the diseased part with a plexus of mycelial branches, which soon give origin to the first or *Milowia* form of fruit, which consists of simple or branched, upright, septate branches, becoming gradually narrowed upwards and remaining perfectly colourless. In due course the apical portion of each erect branch becomes ruptured, and the contents grow out through the torn apex as a chain of spores which readily separate from each other, and germinate at once (Figs. 3 and 4). This form of fruit is very ephemeral and is rarely seen in the field, although in pure cultures it forms a snow-white, mould-like stratum. It alone is responsible for the spread of the fungus in the form of an epidemic during the early stage of growth of the host-plant, but it does not appear to be capable of infecting the root of a mature plant. The spores retain their power of germination for a very limited period of time, not more than one month so far as my experience goes. I first met with this stage of *Thielavia* forming a delicate white mould at the base of a dying plant of *Blysmus compressus*, and at the time considered it as an entity and worthy of generic rank, and published it as *Milowia nivea*. Saccardo afterwards placed *Milowia* as the type of a new tribe of the *Hyphomycetes* which he established under the name of *Milowieae*. The spores or conidia are somewhat variable in size, thin-walled, cylindrical with truncate ends, and average $15–25 \times 4–6\mu$.

As the *Milowia* stage of fruit disappears, the mycelium developed externally on the host, becomes tinged brown, and gives origin to a second or *Torula* form of fruit. In fact the *Milowia* and *Torula* stages may sometimes be met with on the same branch of mycelium (Fig. 5); in such instances the *Torula* or second phase of the fungus always occupies the youngest or apical portion of the mycelial branch. The *Torula* spores are comparatively quite large, clavate and multiseptate, at first thin-walled and colourless, but gradually changing to a dark brown and eventually becoming quite opaque. The cell-walls also increase considerably in thickness during the growth of the spore. When the spores are mature they break up into their component cells, which resemble discs of varying thickness and are circular or more or less obtusely polygonal in

outline. These detached cells or chlamydospores cannot be induced to germinate at the moment of maturity, but do so readily after remaining in a passive condition for some months. This phase of the fungus is usually the only one observed, unless special watch is kept, being rendered conspicuous by the copious production of spores, which often form black, crust-like patches on the diseased root and collar of the host-plant. The spores vary considerably in size, and may be straight or curved, average size $40–65 \times 12–20\mu$ at the widest part near the apex. This stage of *Thielavia* was first observed, in 1850, by Berkeley and Broome, who considered it as a member of the genus *Torula*, and described it as *T. basicola*. It was found at the base of stems of peas, and of *Nemophila*. Respecting its propensities, the authors wrote as follows. "It is either destructive of the plant on which it grows, or is developed on it in consequence of previous disease." From an economic standpoint, this is the most dangerous phase of the fungus, as the resting spores enable the parasite to tide over that portion of the year when its host-plants, which are mostly annuals, are not in active growth. These resting spores germinate readily on dung and produce the *Milowia* and *Torula* forms of fruit on this matrix, in fact the fungus appears invariably to commence life as a saprophyte, and when conditions are favourable, as expressed by the presence of rootlets of seedlings, it assumes a parasitic habit; otherwise it can pass through all the phases of its life-cycle as a saprophyte. In fact the fungus at best is but a very imperfect parasite, the vegetative mycelium first resulting from the germination of the spores being alone parasitic, but its action is sufficient to cripple if not completely to kill the host. The various forms of fruit are then produced externally on the host, which it has previously killed. I have repeatedly observed the *Torula* follow the *Milowia* stage, when the fungus was growing on pea seedlings infected with diseased portions of plants killed by the fungus, and have also observed the same sequence when a pure culture of *Milowia* spores was used.

The third and highest or ascigerous form of fruit was first described by Zopf in 1876. This author also observed the *Milowia* and *Torula* stages of the fungus, and connected the two with his recently discovered ascigerous stage, to which he gave the name of *Thielavia*. The perithecium is minute, subglobose, blackish, glabrous, without a stoma or aperture, $80–120\mu$ in diameter (Fig. 7). Asci numerous, broadly ovate, 8-spored (Fig. 8). Spores cylindrical, with rounded ends, and often slightly curved, or approaching to lemon-shaped, 1-celled, smooth, more or less lenticular or laterally compressed, coloured, $10–12 \times 5–6\mu$ (Fig. 9). This is undoubtedly the least known stage of *Thielavia*, due to the fact that it is only produced on dead, dry and more or less disintegrated portions of the host-plant. Up to the present, it has not occurred in artificial cultures.

Affinities.

Zopf, Winter and Saccardo consider that *Thielavia*, should be placed in the *Perisporiaceae*, Sub. Fam. *Perisporiae*, next the genus *Orbicula*. This I also consider to be its natural position. Fischer, on the other hand, places *Thielavia* in the family *Aspergillaceae*, and

considers it as most closely allied to the common blue moulds included in the genera *Aspergillus* and *Penicillium*.

The synonymy is as follows :—

Thielavia basicola, *Zopf*, Sitz. Bot. Ver. Prov. Brand. 18, p. 101 (1876); *Torula basicola*, B. and Br., Ann. Nat. Hist. ser. 2, 5, p. 461 (1850); *Helminthosporium fragile*, Sor., Hedw. 15, p. 113 (1876); *Milowia nivea*, Mass., Journ. Roy. Micr. Soc. 4, p. 841 (1884); *Clasterosporium fragile*, Sacc., Syll. Fung. 4, p. 386 (1886).

Distribution.

The fungus was first observed by Berkeley in England in 1850. It has also been recorded from France, Germany, Italy, Russia, the United States and Cuba. It has proved to be very destructive to cultivated crops in Italy, Germany and the United States, and is probably much more widely distributed in the soil than is generally suspected.

Now that a simple and certain method for determining its presence has been discovered we are in a position to anticipate it and to act accordingly, as the means necessary for its arrest are practical, inexpensive and effective.

In England its distribution is certainly widespread ; seedling asters and sweet peas, more especially, have been received at Kew in large quantities from practically every part of the country ; many weeds also suffer from its presence. Excluding trees and woody plants, the fungus appears to be practically omnivorous.

It has been recorded as parasitic on plants belonging to the following genera: *Apium* ; *Aralia* ; *Aster* ; *Begonia* ; *Beta* ; *Blysmus* ; *Cochlearia* ; *Cyclamen* ; *Daucus* ; *Lathyrus* ; *Lupinus* ; *Cypripedium* ; *Nemophila* ; *Nicotiana* ; *Onobrychis* ; *Pisum* ; *Scorzonera* ; *Senecio* ; *Trigonella* ; *Viola*. In some instances the injury caused by this fungus assumes serious proportions and the tobacco crop, both in Europe and in the United States, has suffered to the greatest extent. In this country the disease has assumed the proportions of an epidemic in the case of asters and peas, in fact during the past few years it has become practically impossible in certain districts to grow asters, the seedlings being destroyed wholesale. Sweet peas also suffer to a very serious extent in many places, and culinary peas to a less extent.

Cultures of the Fungus.

The conidia of the summer stage (*Milowia*) germinate freely within twenty-four hours in water. As a rule only one germ-tube is produced from one end of the conidium. In those instances where two germ-tubes are produced one from each end of a conidium, one of the germ-tubes continues to grow vigorously, the other remaining small and stunted, and eventually dying. The conidia only retain their vitality for about ten days, and no conidium was observed to germinate after it had been liberated for more than a fortnight. Germination is most vigorous immediately after the conidia are liberated, and the percentage of germination decreases daily with the increasing age of the conidia. As compared with a neutral medium, the presence of a slight amount of acidity in the nutrient solution favours germination and the development of

mycelium, whereas, on the other hand, a trace of akalinity in the nutritive medium retards germination and subsequent growth of the mycelium. The conidia also germinate freely on moist stable manure, covering the surface within a week with the snow-white tufts of the *Milowia* stage of the fungus, which is followed by the black masses of conidia forming the *Torula* stage. The ascigerous condition was not observed. The fact that the fungus can produce its two conidial phases as a pure saprophyte is a point of great importance from an economic standpoint, and suggests the importance of burning all diseased plants, lest they should by any chance find their way to the manure heap, from whence the conidia of the *Torula* stage of the fungus would eventually be returned to the land in a condition favourable for germination. By such means the widespread occurrence of the fungus may probably be explained.

The chlamydospores resulting from the breaking up of the *Torula* form of fruit do not germinate until after a period of rest, and serve to tide the fungus over that period when living host-plants are not forthcoming.

Chlamydospores obtained from aster seedlings that had been dried for a year germinated in a very dilute solution of stable manure, at the end of four days, and another batch of chlamydospores obtained from the same source, germinated on sterilised stable manure, and produced the *Milowia* form within a week, followed by the *Torula* form. Experiments prove that the *Milowia* conidial form constantly reproduces itself; this takes place so long as climatic conditions are favourable for its development, and the distribution of the fungus in space depends entirely on its *Milowia* conidial phase.

A batch of orchids (*Cypripedium*) attacked by *Thielavia*, was sent to Kew for investigation. The basal portion of each plant was soft and decayed, and covered on the surface with a dense, black, crusty layer consisting of the *Torula* condition of the fungus. When placed in a damp chamber at the ordinary temperature of the laboratory, the white *Milowia* stage of the fungus developed within a few days, and gradually encroached on the still living green portion of the leaves. This material, available in quantity for the first time, enabled a series of experiments to be made on the action of the fungus on germinating seeds and on seedlings.

Twelve "marrow fat" peas were planted in each of two Petri dishes, in soil sterilised by steam and afterwards mixed with a copious growth of the *Milowia* form of the *Thielavia*. A third Petri dish used as a control, was prepared in a similar manner, excepting that no fungus was mixed with the soil. After a period of ten days five seedlings appeared above ground in one of the infected dishes and three seedlings in the other. All these seedlings however died within a few days. On examining the peas that had not appeared above ground, it was found that both plumule and radicle had in every instance been killed by the fungus, as was also the case with those that appeared above ground at a later stage. All the peas in the control dish germinated and produced healthy seedlings. No success attended the many attempts to infect the leaves or above-ground portion of the stem of peas with the *Milowia* stage of the fungus. Seedlings of the Shepherd's purse (*Capsella*

Bursa-pastoris), were also killed by the fungus. On the other hand germinating oats were not attacked, neither were those of another grass, *Briza maxima*. Four Petri dishes containing ordinary garden soil, sterilised by steam and afterwards infected with *Thielavia* in the *Milowia* stage, obtained from a pure culture on manure, were prepared. Two of these were flooded with one per cent. of formalin in water for an hour, after which the liquid was poured off and the soil allowed to remain for a week, when all trace of the smell of formalin had disappeared. The soil in the two remaining dishes was left untreated. Twelve peas were placed in each dish. At the expiration of ten days, all the peas in the two dishes treated with formalin were making vigorous growth, whereas in one of the dishes not treated with formalin, no growth appeared above the surface of the soil, and in the second untreated dish four sickly seedlings continued to grow for a few days, but finally collapsed with one exception. When peas germinate in pure sand, mixed with the *Milowia* stage of the fungus attached to fragments of manure, infection of the seedlings occurs, whereas when spores of the *Milowia* stage of the fungus alone are mixed with the sand, no infection takes place. This, along with experiments already recorded, proves that the germinating spores of the fungus cannot infect a host-plant directly, but only after the mycelium has existed for some time as a saprophyte, on humus or decaying vegetable matter.

Symptoms of the Disease in Sweet Peas.

In those instances where the land is badly infected, the majority of the peas do not appear above ground at all. This occurs when both the plumule and radicle are attacked. In such cases if a number of the peas are dug up and placed with sterilised manure in a Petri dish, the contents kept moist and at a temperature of about 65° F., the white *Milowia* condition of the fungus will appear on the surface of the manure within a few days. In the majority of cases the root only is attacked, at least at first, and the plant often attains a considerable growth before any sign of injury appears, but suddenly the plant may begin to wilt, turn yellow, and die, or in some instances only one branch dies, the rest of the plant remaining green for some time, but rarely producing perfect fruit. Another very common symptom of the disease is known to growers of sweet peas under the name of "streak" or "stripe," characterised by the presence of dingy yellow streaks or stripes on the leaves and stem. This condition is the result of what may be termed a mild attack, the fungus not being present in the tissues of the root and collar in sufficient quantity to kill the plant outright, yet sufficiently abundant to prevent the root from performing its function to the fullest extent, hence the stem and leaves lack water and are hungered. The green portions of a plant showing "streak" correspond to the position occupied by the vascular bundles or water-conveying vessels where the limited supply of water obtained by the root makes itself evident, whereas the yellow portions between the veins are dead, owing to lack of water. If the root of a pea plant that has been attacked by the fungus is examined, it will be seen to present a blackened or charred appearance, and very frequently to

be more or less decayed on one side, suggesting the idea that it had been gnawed by wireworm. In some cases small black patches of the *Torula* form of fruit are present on the surface.

Symptoms of the Disease in Asters.

So far as my experience goes, asters are always killed outright during the seedling stage. When the plants are about three inches high they commence to wilt, and soon fall over as in the disease known as "damping off." The roots of diseased plants are shrivelled and blackened, and all the rootlets are dead. The fungus appears to spread very rapidly in the soil, as whole batches of seedlings collapse simultaneously.

Symptoms of the Disease in Orchids.

I have only observed the disease on cultivated species of *Cypripedium*, of which abundant material was sent to Kew, and it was stated to be present on most of the plants occupying a large house. The roots are attacked first, then the bases of the leaves, which gradually become brown and finally assume the condition of a soft rot, when the whole plant falls over. The snow-white *Milowia* fruit was produced in abundance when the decayed portions were placed under favourable conditions for its growth. It was in all probability the spores of this condition of the fungus that spread the disease from one plant to another in the house, the minute spores being dispersed by wind, syringing, &c.

Preventive Measures.

It is practically impossible to cure a plant that is once infected, as the mycelium is located in the living tissues of the root, and no substance is known that will check or kill such mycelium, without at the same time killing or materially injuring the host-plant. Hence the only means of checking the onslaught of the fungus is by the adoption of preventive measures. The great majority of the disease is obviously due to infected land. No evidence of the presence of spores on peas or other seeds is forthcoming, and would not be expected to occur, when it is remembered that the fungus, as a parasite, confines itself to the root and collar of the stem. Infection of the soil may be brought about by various means. When a diseased crop is grown, the roots in most instances become thoroughly decayed, and too friable to remove even if an attempt was made to do so. It is on such decayed roots that the *Torula* or resting-spore stage of the fungus grows, consequently the soil becomes infected, and even if a crop of some kind is afterwards grown that the fungus cannot attack, it finds host-plants in the various kinds of weeds growing along with the crop. In addition, when it is remembered that the fungus can pass through its complete course of development as a pure saprophyte, feeding on the humus present in the soil, it will be readily understood that when land is once infected, the fungus is quite capable of holding its ground, and of quickly extending its area of devastation, unless prompt measures are taken. The infection of a new area is in the majority of instances due to the use of manure, on which material the fungus flourishes and reproduces itself at a rapid rate.

Commercial formalin (= 40 per cent. formaldehyde), has proved to be the most effective fungicide for sterilising infected soil. In the United States, where *Thielavia* proves very destructive in causing a root-rot of tobacco seedlings, the soil of the seed-beds is thoroughly soaked with a solution of formalin in water, in the proportion of one pint of formalin to twelve gallons of water. One gallon of the mixture should be allowed for each square foot of surface. After the watering is completed the soil should be covered for two or three days with coarse sacking or canvas, to keep in the fumes. The watering should be done after all digging has been done and when the seed beds are in a condition ready for sowing, and a week or ten days should intervene between the soaking of the soil and the sowing of seed, to allow for the complete escape of the formalin fumes and the drying of the soil.

When green manure is dug into land intended for seed beds it should previously be thoroughly watered with formalin as above.

Professor Benincasa has quite recently conducted a series of experiments, as to the best means of checking root-rot of tobacco in seed-beds. Having proved that infected soil is the usual source of injury, and that heating such soil to a temperature of 90° C. does not completely eradicate the disease, comparative tests were made by using ordinary garden soil, pure sand, and volcanic ash or pumice for seed-beds. The plants grown in garden soil were badly infected, seed-beds of sand proved very efficient in controlling the disease, volcanic ash gave the best results of all, both in arresting the disease, and in the rapid and vigorous growth of the seedlings. This result is partly due to the absence of humus, which favours the continuous growth of the fungus in soil containing organic matter, and also to the physical conditions of such soil.

The author suggests the use of coal ashes, volcanic scoria, or naturally or artificially powdered volcanic rocks, as suitable for the formation of seed-beds.

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Explanation of Plate.

Figs. 1 and 2 nat. size, the remainder highly magnified.

Fig. 1. Root of Sweet Pea injured by the fungus.
„ 2. Root of *Cypripedium* injured by the fungus.
„ 3. Conidial (*Milowia*) stage.
„ 4. Free conidia, some germinating.
„ 5. Resting-spore (*Torula*) stage.
„ 6. Free resting-spores.
„ 7. Perithecium of ascigerous stage.
„ 8. Ascus containing eight spores.
„ 9. Free ascospores.

IV.—AFRICAN BUXEAE.

J. Hutchinson.

Baillon, in his careful monograph of the *Buxaceae*, published in 1859, regarded them as a separate order and divided the genus *Buxus* containing 13 species into two sections: (i.) *Eubuxus* and (ii.) *Tricera*. These sections besides occupying separate geographical areas are distinguished on account of differences in the form of the inflorescence. In both of them the anthers are supported by well-developed filaments and in the male flowers a large rudimentary ovary is present. At the time of Baillon's monograph no species was known to occur on the African continent, but he recorded and described one from Madagascar (*B. madagascarica*) without, however, having seen male flowers.

Müller in 1869 (DC. Prodr. xvi. i. 13–20) adopted Baillon's arrangement, adding 5 other species.

Baillon in 1873 (Adansonia xi. 268) described *B. Hildebrandtii*, and named it after the collector who found it in the mountains of Somaliland. He pointed out its close affinity with the other Old World species.

Oliver in 1882 (Hook. Ic. Pl. t. 1400) described and figured the genus *Notobuxus*, from Natal, which differs from *Buxus* in having two additional stamens, sessile anthers, and by the absence of a rudimentary ovary from the male flowers.

The same author four years later (l.c. t. 1518) figured and described *Buxus Macowani*, from British Kaffraria, and at the same time pointed out that it differed from *Buxus*, as previously known, by its sessile anthers and by the suppression of the rudimentary ovary in the male flowers.

Gilg in 1899 (Engl. Jahrb. xxviii. 114), described a new genus, *Macropodandra*, from specimens collected by Stuhlmann in the forests at Wabadso on the Uganda border of the Belgian Congo, but I am unable to distinguish this genus from *Notobuxus*, Oliv., and can only regard it as a distinct species. The same author (l.c. 115) recorded a new species of *Buxus* (*B. benguellensis*) from Angola which is very closely allied to *B. Macowani*, Oliv. from South Africa and the examination of male flowers, all collected by Mr. Gossweiler, proves that both species have the same floral structure.

A root disease of Sweet-peas, Asters, &c.

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Van Tieghem in 1897 (Ann. Sci. Nat. Sér. viii., v. 289), gave a general review of the whole group, and divides *Buxus* into four genera which are chiefly distinguished by differences in anatomical structure. *Buxus* he restricts to the extra-African Old World species; *Buxanthus* he establishes on *Buxus Hildebrandtii*, Baill., and on a Socotran plant which he rightly separates from that species and names *Buxanthus pedicellatus; Buxella* includes Baillon's Mascarene species and *Buxus Macowani*, Oliv.; *Notobuxus*, Oliv. is retained and finally the West Indian section *Tricera* is restored to generic rank.

Pax in 1900 (Engl. and Prantl, Pflanzenfam. Nachtr., ii., 38), reduced Van Tieghem's two new genera to *Buxus*, § *Eubuxus*. This in part is also the writer's opinion with the exception that *Buxella* is considered to be a section distinct from *Eubuxus*. Whether *Buxella* should be treated as a section or as a distinct genus is not of great moment, but it should include *Buxus benguellensis*, Gilg, and a new species from Nyasaland described below as *B. nyasica*.

The species included under *Buxella* differ from the remaining species of *Buxus* by having sessile anthers and by the absence of a rudimentary ovary, and further they are confined to the Southern Hemisphere where no other Box trees occur. They constitute a group which is practically intermediate and apparently forms a connecting link between *Buxus* and *Notobuxus*.

Buxus.

§ **Eubuxus**. Anthers supported by filaments; rudimentary ovary present in the male flowers.

Inflorescence sessile or subsessile; male flowers sessile or nearly so; sepals ovate, woolly-ciliate; female sepals shortly pointed, coriaceous, woolly-ciliate.

1. *B. Hildebrandtii.*

Inflorescence pedunculate; male flowers shortly pedicellate; sepals lanceolate, shortly and sparingly ciliolate; female sepals truncate, submembranous, not ciliate.

2. *B. pedicellata.*

§ **Buxella**, sect. nov. (genus, Van Tieghem). Anthers sessile; rudimentary ovary absent from the male flowers.

Leaves rhomboid-obovate or oblanceolate, rounded or emarginate at the apex, less than 2·5 cm. long.

Nerves distinct on the upper surface.

3. *B. benguellensis.*

Nerves not or scarcely visible on the upper surface.

4. *B. Macowani.*

Leaves ovate or lanceolate, acuminate or acute, rarely obtuse, more than 3 cm. long.

Leaves ovate or ovate-oblong, sometimes subcordate, acute or obtuse. 5. *B. madagascarica.*

Leaves lanceolate, long and gradually acuminate.

6. *B. nyasica.*

1. **B. Hildebrandtii**, Baill. Adansonia vol. xi. p. 268.
B. calophylla, Pax in Engl. Jahrb. xxxix. 632.

Buxanthus Hildebrandtii, Van Tieghem in Ann. Sci. Nat. Sér. VIII. v. 326.

TROPICAL AFRICA. Harar: Diredana, *Rosen !* Somaliland: Ahl Mountains, Maid, 800–2000 m., *Hildebrandt*, 1547 ! 891 ! Golis Range, *Mrs. E. Lort Phillips ! Drake-Brockman*, 289 !

Mrs. Lort Phillips states that this species occurs all over the Golis Range, attaining a considerable height in places where the undergrowth is thick and otherwise bushy.

Pax (l.c.) was evidently under the impression that Baillon's type came from Socotra.

2. **B. pedicellata**, *Hutchinson* (comb. nov.).

Buxanthus pedicellatus, Van Tieghem in Ann. Sci. Nat. Sér. VIII. v. 320.

Buxus Hildebrandtii, Balfour, Bot. Soc. 269, *non* Baill.

As Van Tieghem's description is in note form I take the present opportunity of drawing one up from the complete material at Kew.

Frutex 3 m. altus; rami subteretes vel angulares, glabri vel minute puberuli. *Folia* oblanceolata, rotundato-obovata vel suborbicularia, apice rotundata vel leviter retusa, basi attenuata vel cuneata, 2–4 cm. longa, 0·5–2·5 cm. lata, integra, rigide coriacea, supra subnitida, subtus pallida, utrinque glabra, nervis lateralibus utrinque 4–6 plerumque indistinctis. *Inflorescentia* e cymulis 3 vel 4 constituta, axillaris, pedunculata; cymulae 3–5-florae, flore terminali ♀ vel omnes ♂; pedunculi ad 7 mm. longi, angulares, glabri; bracteae lanceolatae, subacutae, 2–3 mm. longae, inferne breviter ciliolatae; ♂ pedicelli ad 2 mm. longi, angulares. *Flores* ♂. *Sepala* lanceolata, vel ovato-lanceolata, subacuta, 2 mm. longa, 1–1·5 mm. lata, margine membranacea, breviter ciliolata. *Stamina* 4; filamenta carnosa, 2·5–3 mm. longa; antherae ovatae, obtusae, 1·5 mm. longae. *Ovarii rudimentum* globosum, verrucosum, 1·25 mm. diametro, glabrum. *Flores* ♀. *Sepala* truncata, membranacea, eciliata. *Ovarium* glabrum; styli crassi, recurvi, circiter 3 mm. longi. *Capsula* 1–1·2 cm. longa, tricornuta. *Semina* 7 mm. longa, nitida, brunnea.

SOCOTRA. *Balfour*, 637 ! *Schweinfurth* 415 ! *Bent ! Hunter.*

Balfour states that this tree is very abundant in the island; the wood is extremely hard.

3. **B. benguellensis**, *Gilg* in Engl. Bot. Jahrb. xxviii. 115.

TROPICAL AFRICA. Angola: Huilla, *Antunes*, A. 46 ! 248 !

Var. **hirta**, *Hutchinson*, var. nov.; a typo ramulis et foliis subtus breviter pubescentibus recedit.

ANGOLA: 10 miles north of the river Lifuni, *Gossweiler*, 4901 !

Mr. Gossweiler's plant appears to be a pubescent form of *B. benguellensis*, the type of which, thanks to the courtesy of Prof. Engler, I have had an opportunity of examining. Male flowers of this species have not hitherto been described, and as they were collected by Gossweiler, a description is given.

Flores ♂ solitarii, axillares, subsessiles, bracteis squamiformibus 3 vel 4 subtendentibus. *Sepala* 4, decussata, ovato-elliptica, obtusa, 1·5 mm. longa, 1–7·5 mm. lata, medio leviter coriacea, ad marginem membranacea, glabra. *Stamina* 4; antherae sessiles, 1·5 mm. longae, glabrae. *Ovarii rudimentum* nullum.

4. **B. Macowani**, *Oliv.* in Hook. Ic. Pl. t. 1518 ; Sim, Forest Fl. of Cape Colony, 321, pl. 145, fig. 1.

Buxella Macowani, Van Tieghem in Ann. Sci. Nat., Sér. VIII., v. 326.

SOUTH AFRICA. East London : in primitive woods near Kwelegha, *Hutchins in Herb. Macowan*, 916 ! in the " Park," *Flanagan*, 1727 !

5. **B. madagascarica**, *Baill.* Monogr. Buxac. 65 ; Muell.-Arg. in DC. Prodr. xvi. i. 18.

Buxella madagascarica, Van Tieghem in Ann. Sci. Nat., Sér. VIII., v. 326.

MADAGASCAR. *Du Petit Thouars.* An example of this species has not been seen.

6. **B. nyasica**, *Hutchinson*, sp. nov. ; species foliis lanceolatis vel subovato-lanceolatis longe acuminatis, antheris sessilibus, floribus ♂ ovarii rudimento nullo valde distincta.

Frutex vel *arbor* ; rami subteretes, leviter sulcati, glabri ; ramuli juniores paullo complanati, glabri. *Folia* lanceolata vel subovato-lanceolata, apice acuta, sensim longe acuminata, basi cuneata, 4·5–6·5 cm. longa, 1·2–2·2 cm. lata, integra, tenuiter coriacea, supra leviter nitida, subtus opaca, utrinque glabra, nervis lateralibus utrinque 15, e costa media sub angulo 45° divergentibus intra marginem arcuatis nervo marginale composita margine 2 mm. distante utrinque conspicuis ; petioli breves vel subnulli. *Flores* in axillis infimis plerumque ♂ et ♀ solummodo sed nonnunquam duo ♀ , pedicelli 2·5 mm. longi, bracteis imbricatis triangularis obtecti. *Flores* ♂. *Sepala* 4, late ovato-triangularia, dorso paullo carinata, circiter 1 mm. longa, glabra, margine membranacea. *Stamina* 4 ; antherae sessiles, acutae, vix 5 mm. longae, dorso 1 mm. latae. *Ovarii rudimentum* nullum. *Flores* ♀. *Sepala* maris. *Ovarium* glabrum ; styli 3, patuli, minute bifidi, intus sulcati et stigmatosi, 3·5 mm. longi, glabri. *Capsula* et semina non visa.

TROPICAL AFRICA. Nyasaland : Shiré Highlands ; Milanji, *Scott Elliot*, 8603 ! (typus in Herb. Berol.).

NOTOBUXUS.

Leaves obtuse or emarginate, not acuminate ; male flowers sessile or subsessile. 1. *N. natalensis.*

Leaves acutely acuminate; male flowers pedicellate. 2. *N. acuminata.*

1. **N. natalensis**, *Oliv.* in Hook. Ic. Pl. t. 1400 ; Sim, Forest Fl. of Cape Colony, 320, pl. 145, fig. 2.

SOUTH AFRICA. Natal : Inanda, *Wood*, 374 ! 1357 ! Durban, *Schlechter*, 2797 ! Tongaat, *Cooper* ! Pondoland : Port St. John, in forest at West Gate, *Galpin*, 3471 ! Egossa, *Sim*, 2424 ! 2427 ! Transkei : Kentani ; Manubi forest, common shrub 4–6 ft., *Pegler*. 1258 !

2. **N. acuminata**, *Hutchinson* (comb. nov.).

Macropodandra acuminata, Gilg in Engl. Bot. Jahrb. xxviii. 114.

TROPICAL AFRICA. Belgian Congo ; Wabadso, in forests, *Stuhlmann*, 2647 !

V.—MISCELLANEOUS NOTES.

Mr. R. Gill.—We learn that Mr. R. Gill, whose appointment as a Curator in the Agricultural Department of Southern Nigeria was recorded in *K.B.* 1909, p. 315, has been appointed an Assistant Superintendent of Agriculture in that Department.

J. S. Slater.—John Samuel Slater was the third son of the late Rev. Samuel Slater, D.D., Rector of Stenigot, Lincoln, and some time Headmaster of Bishop Cotton School, Simla. He was born in Calcutta in 1850, educated at Pocklington Grammar School, Yorkshire, and Bishop Cotton School, Simla. He graduated in 1870 at the Thomason Civil Engineering College, Rurki, obtaining the Gold Medal for Mathematics. The same year he was appointed to the Public Works Department of the Government of India and served at Dera Ghazi Khan and other places in the Punjab.

In 1875 he was appointed Professor of Engineering at the Presidency College, Calcutta, and when the Engineering Department of that College was formed into an independent residential Engineering College at Sibpur he took a leading part in its organisation, became one of the original members of its staff and was eventually appointed Principal in 1891.

He inaugurated a scheme of modern education for the District Schools of Bengal and Assam and was responsible for the reorganisation of the technical schools of those two Provinces. In 1897 he was appointed Inspector of Schools of the Rajshahi Division and in 1901 officiated as head of the Educational Department of Bengal; in 1904 he was incapacitated by a serious illness which necessitated his retirement from India in that year.

Slater was responsible for teaching Astronomy to the students of the Engineering College and was always keenly interested in that science. In 1891 while on leave he devised and patented an armillary sphere which has proved of great value for instructional purposes. He was elected a Fellow of the Royal Astronomical Society in 1892.

After his retirement Slater devoted himself enthusiastically to an investigation of the pollen of plants and prepared by micro-photography a large number of enlarged photographs of pollen grains. In accordance with a wish which the deceased had expressed, the whole of his specimens and photographs were presented by his executors to the Royal Botanic Gardens, Kew.

He married in 1873 Jessie Frances, only daughter of Surgeon-Major John Bean, attached to the Royal Irish Fusiliers, by whom he had a son, deceased, and a daughter who is married to Mr. B. Heaton, the present Principal of the Sibpur Engineering College.

He died at Ealing on 7th April, 1911, aged 61.

B. H.

W. Don.—We learn with regret, through the Colonial Office, of the death of Mr. William Don, Curator in the Agricultural Department of Southern Nigeria, on December 10th, 1911. Mr. Don

was educated and brought up in Lady Breadalbane's Orphanage at Kenmore, and served his apprenticeship in Taymouth Gardens. He came to Kew from Whittinghame in 1902, and in the following year was appointed Assistant Curator to take charge of the new Botanic sub-station at Tarkwa, in the western part of the Gold Coast Colony (*K.B.* 1903, p. 31). Two years later he was transferred to the service of the Government of Southern Nigeria and was placed in charge of the Botanic Gardens at Old Calabar (*K.B.* 1905, p. 61). Mr. Don visited Kew in accordance with custom during his leaves of absence from the Colony, and in the spring of 1910 was permitted by the Secretary of State for the Colonies to visit the Colonial Museums at Hamburg and Haarlem. He had returned to England again on leave at the end of September and had intended taking a course of Entomology at the London School of Tropical Medicine. He died very suddenly of acute pneumonia at Taymouth Castle, Aberfeldy, Perthshire, in his 33rd year.

West Indian Agricultural Conference, 1912.—An invitation was received at the end of October from the Commissioner of Agriculture, West Indies, for a representative of the Royal Botanic Gardens, Kew, to attend the West Indian Agricultural Conference to be held at Trinidad from January 23rd—30th, 1912. With the sanction of the President of the Board of Agriculture and Fisheries, this invitation has been accepted, and the Assistant Director has been deputed to attend the conference as the representative of Kew.

Visitors during 1911.—3,704,606 visitors to the Royal Botanic Gardens have been recorded during the year 1911. These figures show an increase of 158,304 over those of the previous year and are the largest on record. During the ten years 1901–10, 22,459,027 persons have visited the gardens giving an average of 2,245,902. The total number of visitors on Sundays, during 1911, was 1,517,650 and on weekdays 2,186,956.

The largely increased number of visitors during the past year must be attributed mainly to the remarkable spell of brilliant summer weather and also to the large number of visitors to London in connection with the Coronation. As in 1910, there have been five Bank Holidays and the attendances on Easter Monday, Whit-Monday and the August Bank Holiday were 144,084, 157,425 and 115,833 respectively. The total number of visitors for the five holidays was 446,644, as against 424,010 in 1910.

Sunday visitors have decreased by 96,435, while the number of visitors on week days show an increase of 254,739.

The greatest attendance on any one day was, as has commonly been found to be the case, on Whit-Monday, when there were 4,971 more visitors recorded than for the corresponding day in the previous year which previously held the record for a single day.

The smallest number on any one day was 179 on December 20th.

The largest Sunday attendance was 88,005 on June 4th, and the smallest 423. The former figures show a decrease of about 3,000 from those recorded last year.

The detailed monthly returns are given below.

January	55,328
February	131,674
March	158,075
April	288,239
May	468,014
June	687,302
July	737,946
August	530,859
September	373,294
October	173,250
November	63,658
December	36,967
	3,704,606

Additions to Gardens, 1911.—Additions to the collections of plants cultivated at the Royal Botanic Gardens, Kew, have been made during the year by exchanges with other gardens, private as well as public, and by purchase from nurserymen and others. Contributions of plants and seeds received from Botanic Gardens and other institutions include the following :—

British Guiana. Plants brought over for the Rubber Exhibition.

Calcutta. Tubers of *Arisaema* ; collections of seeds from the Himalayas.

Darjeeling. Orchids.

Dunedin. Collections of plants and seeds.

Laeken. Tropical plants.

Manila. Collection of seeds.

New York. Succulent plants.

Singapore. Two Wardian cases of ferns ; seeds.

Sydney. Collection of seeds.

United States Department of Agriculture. Plants and seeds.

Exchanges were made with the Botanic Gardens of Edinburgh, Glasnevin, Cambridge and Oxford, and with most of the European gardens upon whom Kew is largely dependent for seeds of those annual herbaceous plants which fail to produce seeds at Kew.

Mr. W. Fox gave plants and seeds collected by him in the Amazon region. Mr. J. Gossweiler sent seeds from Angola. Dr. M. Grabham, Madeira, presented a quantity of *Orchis foliosa*. Dr. Schönland, the Albany Museum, Grahamstown, presented Euphorbias. Lady Hanbury, Ventimiglia, sent succulents, and a collection of seeds. Mr. J. C. Harvey, Mexico, presented plants and seeds. Dr. Kerr, Siam, gave plants and seeds. The Imperial Institute presented stems of *Castilloa lactiflua*. Lord Li Ching-fong (late Chinese Minister in London) sent Nelumbiums from China. Mr. C. J. Lucas, Warnham Court, sent Sobralias, Epidendrums, and other plants. Miss M. H. Mason, Cape

Colony, presented a collection of seeds. The Natural History Museum, South Kensington, gave Musas from the Canary Islands. Prof. H. H. W. Pearson, Cape Town, presented collections of succulents obtained by the Percy Sladen Expedition, seeds collected in Angola by Dr. McClelland Harrison, and *Freesia* corms. Seeds of *Welwitschia* were received from the Botanic Gardens, Groningen. Dr. Perez, Tenerife, sent seeds of *Juniperus Cedrus*, *Cytisus proliferus* var. *Canariae*, *Echium Pininana* and other interesting Canary Islands plants. Several presentations were made by exhibitors at the Rubber Exhibition held in London in July. Mr. H. Simpson gave a very fine specimen of *Platycerium alcicorne*. The United States National Museum presented succulents. Mrs. Vallentin, Falmouth, gave a collection of seeds from the Falkland Islands.

Among the seeds and plants of interest distributed from Kew during the year were the following :—Chinese *Meconopsis* (seeds), *Cuscuta* sp., Chile (seeds), *Cytisus proliferus* var. *Canariae* (seeds), *Eucommia ulmoides*, *Pinus patula*, *Rhamnus Purshiana* (seeds), *Quercus Ilex* (seeds to British Colonies), *Zizania aquatica*, and new Chinese Rhododendrons.

Two Wardian cases of plants were sent to Zanzibar, three to British East Africa, and one to British Guiana. Surplus trees and shrubs and herbaceous plants were presented to public institutions, and surplus *Nymphaea* tubers to public gardens ; collections of plants were sent to Brussels Botanic Garden, University College, Cork, &c., &c.

Hardy Trees and Shrubs.—As has been the case for several seasons past, the most notable additions in this department during 1911 have been natives of China. The exploitation of the flora of Central and Western China which gave to the first decade of the twentieth century its most marked characteristic so far as horticulture is concerned, was carried on during the early part of the year by Mr. E. H. Wilson, who brought his fourth journey to a successful conclusion in the spring. Kew, in conjunction with H.M. Office of Woods and Forests, was a participator in the enterprise and received in all 381 packets of seeds as its share. Almost every one of these was labelled only with the generic name. Among the new species, those of Abies and Picea will probably arouse the most general interest. They represent some of the last new types of their kind probably the world will yield. The seeds germinated excellently, but unfortunately Kew will not be able to do the plants justice. Conifers as a whole are not well suited at Kew, and, of them all, Abies and Picea are the unhappiest. Fifty-four packets of Rhododendron were received, only one of which (No. 4234) failed. The other genera most strongly represented were Acer, Cotoneaster, Lonicera, Rosa, Spiraea and Viburnum. A Berberis (No. 1284) of Mr. Wilson's collecting during his previous journey flowered, and has since been named *B. Stapfiana* by Dr. Schneider.

Some interesting seeds collected by Mr. G. Forrest on the Lichiang mountains and presented by Mr. J. C. Williams and Mr. Bulley were alluded to in the *Kew Bulletin*, 1911, p. 203. To

Mr. Williams Kew is also much indebted for a fine example of *Enkianthus chinensis* about five feet high—one of the rarest of all shrubs in cultivation.

In March Mr. Maurice L. de Vilmorin sent a most interesting set of over forty miscellaneous trees and shrubs. *Corylus thibetica* and the interesting *Alnus cremastogyne* were amongst them. From Messrs. J. Veitch & Sons 36 Rhododendrons of Wilson's collecting were received. A new lilac previously obtained from the same firm flowered and has been named *Syringa Julianae* by Dr. Schneider. From Miss Willmott came a nice plant of *Cunninghamia sinensis*. This remarkable conifer, is, of course, an old one in gardens, but, as hitherto represented, it has only been a success in a few very favourably situated places. At Kew the trees are severely hit every hard frost. But Mr. Wilson believes that the newly introduced ones (of which Miss Willmott's is one) will prove hardier, as he collected the seeds in the coldest and most inclement parts of the habitat of this tree. The Earl of Annesley sent a good example of the new *Picea morindoides*, still very rare. Mr. Clinton-Baker presented a plant of *Fokienia Hodginsii*, a new genus of Coniferae, also seeds of the Formosan variety of *Cupressus obtusa* and of *Pinus Armandii* var. *Mastersiana*.

From the Arnold Arboretum several consignments of seeds and plants have been received. Amongst the latter some new Magnolias of Wilson's collecting are of especial importance. To a genus of such distinction as Magnolia every addition is particularly welcome. The development of several unnamed Chinese poplars, willows and beeches, sent by Professor Sargent, will be watched with interest. One of the poplars Mr. Wilson describes as even finer than *P. lasiocarpa*, which is itself certainly one of the most wonderful plants recently come out of China, *Salix magnifica*, with oval leaves like those of *Arbutus Menziesii* in shape and colour, but with the blade as much as $8\frac{1}{4}$ inches long by $5\frac{1}{4}$ broad, is another remarkable small tree quite different from any other known willow. In striking contrast with it is *Salix Bockii*, a dainty little shrub with leaves $\frac{1}{4}$ to $\frac{1}{2}$ inch long, and said by Wilson to be extremely pretty in flower. Both these have been received.

Of American trees Mr. F. R. S. Balfour sent seeds of *Rhamnus Purshiana* and acorns of *Quercus densiflora*, a handsome evergreen oak of the Pasania section, whose leaves are clothed with a tomentum milk-white in spring, tawny later. Of this oak only two trees are generally known in the British Isles, both in the collection at Kew. This and the fact that it is becoming scarce in a wild state make its re-introduction welcome. From Messrs. Fisher, Son & Sibray, of the Handsworth Nurseries, we have received among other things six fine American beeches (*Fagus ferruginea*) raised from seeds. The species has long been represented in the beech collection at Kew, but only by grafted trees. As the most striking characteristic of *F. ferruginea* is its habit of producing suckers like an elm, plants on their own roots are very desirable.

Kew has continued to draw on the rich collection of Canon Ellacombe at Bitton for plants which disappear in hard winters. *Aplopappus ericoides* and *Rosa Hardii*, among other things, were this year obtained from him. Mr. M. Phillips Price, of Tibberton

Court, Gloucester, sent unnamed seeds collected by himself in Mongolia during a recent exploring expedition. Some uncommon species and garden varieties of rhododendron were sent by Sir E. G. Loder, Bart., from his fine collection at Leonardslee.

Waterfowl.—During the past year several additions by presentation and exchange have been made to the collection of Waterfowl in the Royal Botanic Gardens. They include :—

1 pair of Fulvous tree-ducks ; 1 pair of Ruddy sheldrake ; 1 pair of Bahama ducks ; 1 pair of Versicolor teal, and a Scaup duck, presented by the Hon. N. C. Rothschild ; 1 pair of Muscovy ducks, presented by the Zoological Society of London ; 1 pair of Demoiselle cranes ; 1 pair of Chiloe widgeon and 1 pair of Brazilian teal, received in exchange from the Zoological Society of London.

The black-necked swans again went to nest but failed to hatch any young birds, and the storks hatched out two young birds as usual, but they were not reared owing to the old birds having been disturbed.

The greatest success was obtained with Carolina ducks, 24 young birds being reared. Three common sheldrake and one red-crested Pochard were also reared, as well as numerous Tufted duck.

Official Visits.—During the past year the vote for travelling expenses has been utilised as follows :—

The Director.—For the purpose of studying at the Herbarium of the Museum d'Histoire Naturelle, Paris.

The Curator.—On visits to the Royal Agricultural Show, Norwich, and to various horticultural establishments at Bruges.

The Assistant Curator.—To visit the Royal Botanic Gardens, Edinburgh.

The Keeper of the Herbarium.—For the purpose of studying the distribution of *Spartina* in the Isle of Wight.

Mr. Brown, Assistant Keeper in the Herbarium.—To study in the herbaria at Berlin and Lubeck.

Mr. Rolfe, Assistant in the Herbarium.—To study in the herbaria at Florence.

Mr. Cotton, Assistant in the Herbarium.—In connection with the Survey of Clare Island, Ireland, and also towards the investigation of the growth of *Colpomenia sinuosa* on the South Coast of England.

The Keeper of the Museums.—To visit the Royal Agricultural Show at Norwich ; to attend the meeting of the Museums Association at Brighton, and to visit Liverpool in connection with the importation of tropical products.

Mr. Dallimore, Assistant in Museums.—To attend the Bath and West and Southern Counties Agricultural Show at Cardiff, and to visit the Forest of Dean ; also to attend the Glasgow Exhibition, the Scottish Arboricultural Society's Excursion, and to visit various estates in Scotland in connection with British Forestry.

Museums.—During the past year considerable progress has been made in generally improving and re-labelling the permanent collections. The work of dealing with the products received from the Japan-British Exhibition was continued and completed, and in this connection it may be recorded that 5500 fully labelled duplicate specimens have been distributed to 50 institutions, including the following :—Avondale Forestry School, Rathdrum, co. Wicklow ; Municipal Museum, Warrington ; Natural History Museum and Art Gallery, Bristol ; Museum, Botanic Gardens, Sydney, N.S.W. ; University, Aberdeen ; Royal College of Science, Dublin ; Science and Art Museum, Dublin ; South Eastern Agricultural College, Wye, Kent ; University, Leeds ; and to the Directors of Education, Glasgow, Liverpool, Cardiff, Birmingham, Hull, London, &c.

Many interesting products have been received from 137 contributors and placed in position in the collections, and those of special interest have been recorded from time to time in the Bulletin.

The Museum Staff has been fully occupied in determining vegetable economic products, and in giving general information on these matters to an increasing number of correspondents.

Collections were prepared from duplicate material, chiefly of subjects bearing upon Forestry, for the exhibit of the Board of Agriculture and Fisheries at the Shepherd's Bush Exhibition, for the Royal Scottish Exhibition, Glasgow, and for the Bath and West and Southern Counties Show, held at Cardiff.

Individual members of the Staff attended the above-mentioned Exhibitions and Shows, the Royal Show at Norwich, the Meeting of the Museums Association at Brighton, and the Annual Excursion of the Royal Scottish Arboricultural Society to the Border Country.

Presentations to Museums.—The following miscellaneous specimens have been received in addition to those previously recorded in the Bulletin :—

The Right Honourable the Earl of Plymouth, St. Fagan's Castle, Cardiff.—Diseased branches of Ash. Larch trunk infested with Aphis. Larch trunk injured by Honeysuckle and afterwards by Canker. Twenty-four photographs of subjects connected with Forestry.

The Right Honourable the Earl of Stanhope, Chevening, Sevenoaks.—Section of wood of *Corylus Avellana*.

Mr. M. P. Price, Tibberton Court, Gloucester.—Section of stem of Saxaul (*Haloxylon Ammodendron*). Used by Tartars as fuel and by Russians on the Central Asian Railway to prevent sand drifting.

The Right Honourable the Earl of Albemarle, Quidenham, Attleborough.—Board of Black Walnut.

Messrs. George Black and Sons, Berwick-on-Tweed.—Model of Creosoting Plant.

Dr. Tromp de Haas, Netherlands Section, International Rubber Exhibition.—Gutta Percha extracted from leaves of *Dichopsis Gutta*. Rubber from *Ficus elastica*.

United Malaysian Rubber Co., International Rubber Exhibition. —Trunk of Jelutong (*Dyera costulata*). Photographs of a Jelutong tree and sample of rubber extracted from "Gutta Jelutong."

Malay Development Agency, International Rubber Exhibition.— Samples of Para Rubber and Gutta Percha.

Mr. R. Fyffe, Uganda Section, International Rubber Exhibition. —Tapped stem of Ceara rubber (*Manihot Glaziovii*) also samples of sheet and biscuit Ceara rubber. Rubber from *Clitandra orientalis*, *Landolphia Dawei* and *Hevea brasiliensis*. Photographs of rubber trees.

Mr. H. Powell, East African Protectorate Section, International Rubber Exhibition.—Rubber from *Mascarenhasia elastica* and *Manihot Glaziovii*. Photograph of a Sisal Hemp (*Agave rigida*, var. *sisalana*) Plantation.

Mr. A. E. Aspinall, West Indies Section, International Rubber Exhibition.—Rubber from *Castilloa elastica*, *Ficus elastica*, *Hevea brasiliensis* and *Funtumia elastica*, also seeds of the latter.

Mr. F. A. Stockdale, British Guiana Section, International Rubber Exhibition.—Rubber from *Sapium Jenmani*, *Hevea confusa*, and *Hevea brasiliensis*.

Mr. W. S. D. Tudhope, Gold Coast Section, International Rubber Exhibition.—Rubber and stem of *Funtumia elastica*. Rubber from *Landolphia owariensis*, *Ficus Vogelii*, and *Hevea brasiliensis*. Flowers and seeds of *Manihot Glaziovii*. Flowers of *Manihot dichotoma*. Seeds of *Hevea brasiliensis*. Rubber tapping knife. Ropes used in climbing by natives. Basket used by natives for carrying rubber, &c.

Mr. W. A. Sturdy, Lindfield, Sussex.—Sections of trunks of *Sequoia gigantea* and *Picea excelsa*.

Mr. T. W. H. Hutchinson, Dumfries.—Examples of Clogs and Clog-soles of Alder and Birch in various stages of manufacture.

The Right Honourable Lord Strathcona, Grosvenor Square, London.—Photographs illustrating the regeneration of Larch and Scots Pine, also photographs of Old Scots Pine, Oak, Beech and Larch.

Mrs. Waterhouse, Newbury, Berks—Cones of *Picea pungens* and of its variety *glauca*.

Superintendent, Royal Botanic Gardens, Calcutta.—Seventeen photographic enlargements of views of Cinchona Plantation and Factory at Munsong, India.

Mr. A. E. Aspinall, West Indian Committee, Seething Lane, London, E.C.—A collection of West Indian Produce from the Coronation Exhibition.

Mr. Charles Coltman Rogers, Stanage Park, Brampton Bryan. —Planks of Alder, Birch, Willow, and Hawthorn. Cones of *Picea rubra*.

Mr. W. Steuart Fothringham, Murthly, Perthshire.—Two models of Stock- and Rabbit-proof water-gates.

The Most Honourable the Marquess of Graham, Brodick Castle, Arran—Section of trunk of Larch.

Sir Hugh Shaw-Stewart, Bart., Ardgowan, Greenock.—Section of trunk of *Abies pectinata*.

Messrs. Alex. Jack and Sons, Ltd., Maybole.—Examples of felloes, spokes and naves of wheels of home grown timbers.

The Most Honourable the Marquess of Ailsa, Culzean Castle, Ayr.—Two sections of Ash.

Mr. R. A. Murray Allan, Glenfeochan, Oban.—Transverse section of Larch.

Mr. Thomas Strachan, Keir Estate, Dunblane.—Model of Field gate made of Yew.

Sir C. T. Dyke-Acland, Bart., Killerton, Exeter.—Plank and transverse section of *Cryptomeria japonica.*

Imperial Commissioner of Agriculture, Barbados.—Photographs of Orange (*Citrus Aurantium*) showing gradations towards a condition similar to that in the Navel Orange.

Curator, Economic Garden, Old Calabar.—Sample of native Cotton Yarn dyed with *Indigofera arrecta.*

Senor Annibal Ferreira da Gama, St. Thomé.—Pods and leaves of the different varieties of Cacao cultivated in St. Thomé.

Curator, Botanic Gardens, Dominica.—Fruits of Monkey Cacao (*Theobroma angustifolia*) from a tree fruited for the first time in Dominica.

Mr. Francis de St. Croix, Jersey.—Fruits of Pomegranate ripened on a tree 16 or 17 years old growing in the open in Jersey.

Canon Ellacombe, Bitton Vicarage, Bristol.—Fruits of Pomegranate ripened in the open at Bitton.

Mr. S. Fraser, Kingussie.—Cones of *Pinus Cembra.*

Messrs. Turnbull and Co., Glasgow.—Nineteen samples illustrative of the destructive distillation of wood.

Presentation of a piece of Plate.—The International Rubber Exhibition held in London in July last was made the occasion of an interesting presentation of a handsome silver salver to the Royal Botanic Gardens, Kew, in commemoration of the part played by this institution in the initiation of the Para rubber industry in the Eastern Hemisphere.

The presentation was made by the Rubber Growers' Association at a banquet held on July 7th, 1911, and the salver was accepted on behalf of the Royal Botanic Gardens by Sir W. T. Thiselton-Dyer.

At the same time a telegram was sent by the Chairman to Sir J. D. Hooker, during whose directorship the introduction of *Hevea brasiliensis* to our Eastern possessions took place. In acknowledging the gift, Sir W. T. Thiselton-Dyer said :—

Sir Henry Blake and gentlemen,—I think the Permanent Secretary of the Colonial Office, who is present with us to-night, will agree with me that this is rather a unique occasion in official history. You know that civil servants serve under the Crown, I think I may say, without fear or expectation of favour. When they do their duty they are subject to a good deal of criticism. They are

very glad when their efforts meet with some success. I can honestly say, as far as I know, that the last thing they expect to get is the smallest credit for it. I find myself now in front of a stupendous piece of plate which Sir John Anderson suggests I should take away under my arm. I confess that I find the situation rather embarrassing, but I am very much comforted when I read the inscription because nothing is more impossible than for a servant of the Crown to receive any substantial recognition of anything he has done. What Kew did in this matter was nothing more than its ordinary routine work. That institution now lives in the third century of its existence. As I have reminded my neighbour, the Consul General for Germany, it was founded in the 18th century by a princess of his nation, who, to adopt the words of Mr. Gladstone, "cast her aspirations into the future" of her adopted country when she founded Kew. We have done many things in the past at Kew. When I say "we," I speak of a considerable procession of predecessors in the 18th century. We—that is Kew—tried in the same way as we engaged in the rubber enterprise to transfer the bread fruit from the Pacific to the West Indies. The mutiny of the *Bounty* grew out of that attempt, and there was a chivalrous predecessor of Mr. Wickham in the Kew gardener, who stuck to the captain, and died from exposure in the boat. Peace has its victims as well as war. Well, we succeeded with regard to rubber. I can assure you that on that 14th of June, when Mr. Wickham arrived at Kew in a hansom cab with his precious bag of seeds, not even the wildest imagination could have contemplated its result in this banquet to-night. What we did was done in the most ordinary and routine way. I was the lieutenant then. My chief, who is now in his 95th year, and who has the vigour of youth, but is not allowed to dine out, would have enjoyed very much to be present here to-night; but there is one whom I miss, who was the prime mover in the enterprise—one to whom your cheer should go up—Sir Clements Markham. (Applause.) He was the prime mover also in introducing the *Cinchona* plant into India and giving India the advantage of quinine. He travelled in South America, and I think that out of quinine the idea came to him that he would round off that part of his life's work by giving to the East rubber as well. When I tell you that owing to Markham the natives of Bengal for a farthing can get 5 grains of quinine at any post office, you will realise what he did with the help of Kew in introducing the *Cinchona* tree into India. In the same humdrum way we did the same with rubber. I saw Mr. Wickham's seeds planted. We knew it was touch and go, because it was likely the seeds would not germinate. I remember well on the third day, going into the propagating house where they were planted and seeing that by good luck the seed was germinating. So rapidly did the plants grow—1,900 of them—that we had to have special cases made. On August 12th, 38 cases went out to Ceylon on a P. and O. steamer in charge of a gardener, but I will not bore you with other details. You yourselves are able to judge of the results and you can appreciate the advantage of Kew taking up a matter of this kind. The whole expense of initiation, and the whole burden of finance from first to last, was borne by the India Office, and the people to whom

the colonies in the East ought to be grateful is the Indian Government, which, I am afraid, has reaped very little advantage. You owe it that debt and it is a deep debt. I would also like to point out that Kew is not merely an isolated institution in a London suburb ; it is in communication with a network of similar institutions all over the Empire, and it has the advantage of being able to command the assistance and co-operation of all of them. It may interest you to know that owing to advice that nothing of the kind would grow in the plains of Bengal, we refrained from sending these precious *Hevea* plants to Calcutta, but with the consent of the Indian Office, which was generous enough under the circumstances, we sent them to the Ceylon Botanic Gardens. From Ceylon we were able to supply the Straits Settlements, and so we planted the *Hevea* in a climate and under physical conditions which were most suited to them. But, as you know, at that time the East was not ready for them ; it required imagination to see their future, but we had scientific colleagues who watched over their growth and helped the enterprise in the best possible way. I need not enumerate their names, they are perpetuated on this salver, which will pass into the custody of my successors at Kew. But I might say a word about my friend, Mr. Ridley, who has assiduously nurtured the rubber industry and fostered its expansion in the Native States. There is nothing more to add except that the thing has been a great success. Kew has attempted many things ; some have failed and some have succeeded ; and, as far as the officials at Kew are concerned, they feel that it is generous of you to make this presentation. I am sorry my successor is not present to-night, or he would have endorsed what I have said. We have but done our duty. Such a gift is no doubt highly irregular ; but what I put to my conscience is that it is not a present to any individual—it is a present to Kew and to the nation, and it will be preserved at Kew as a public memorial. Kew has received many gifts from persons who are anxious to develop its usefulness. This, perhaps, will also answer that purpose as it will give an encouragement for the future. (Applause.)

The salver, which is engraved with the Royal Arms, bears the following inscription :—

PRESENTED
BY A NUMBER OF THOSE INTERESTED IN
THE EASTERN RUBBER INDUSTRY,
TO
THE ROYAL BOTANIC GARDENS, KEW.
TO COMMEMORATE THE INTRODUCTION OF
HEVEA BRASILIENSIS, THE PARA RUBBER,
INTO THE EASTERN HEMISPHERE,
AN ACHIEVEMENT WHICH LAID THE FOUNDATION OF A MOST
IMPORTANT INDUSTRY.

India Office	Clements Markham.
Kew	Hooker, Thiselton-Dyer.
Ceylon	Thwaites, Trimen.
Malay Peninsula	Cantley, Murton, Low, Ridley.
Collectors	Wickham, Cross.

1st July, 1911.

The salver has been placed on exhibition in Museum No. I.

Research in Jodrell Laboratory in 1911 :—

Bancroft, K.—A Pine Disease (*Diplodia pinea*, Kickx). (Kew Bull., 1911, pp. 60–62.)

Boodle, L. A. and **Dallimore, W.**—Report on Investigations made regarding "Beech Coccus" (*Cryptococcus fagi*, Barensprung). (Kew Bull., 1911, pp. 332–343.)

Lawson, A. A.—The Phase of the Nucleus known as Synapsis. (Trans. Roy. Soc., Edinburgh, Vol. xlvii., part 3, pp. 591–604, tt. 1 and 2.)

Maslen, A. J.—The structure of *Mesoxylon Sutcliffii*, Scott. (Ann. Bot., Vol. xxv., pp. 381–414, tt. 33–36.)

Massee, G.—A Disease of the Lilac (*Helminthosporium syringae*, Klebahn). (Kew Bull., 1911, pp. 81–82, with one plate.)

[Massee, G.]—The use of Carbon Bisulphide. (Kew Bull., 1911, pp. 169–170, with fig. in text.)

Massee, G.—A New Paint-destroying Fungus (*Phoma pigmentivora*, Mass.). (Kew Bull., 1911, pp. 325–326, with one plate.)

[Massee, G.]—Root Tumours of Sugar-Beet. (Journ. Board Agric., Vol. xvii., pp. 830–831, with one plate.)

[Massee, G.]—Blister-Canker of Apple Tree (*Nummularia discreta*, Tul.). (Journ. Board Agric., Vol. xviii., pp. 314–315, with one plate.)

[Massee, G.] A Cucumber and Melon Disease New to Britain. (Journ. Board Agric., Vol. xviii., pp. 670–671, with one plate.)

Takeda, H.—The Japanese Species of *Cerastium*. (Kew Bull., 1911, pp. 100–109, with one plate.)

[Turrill, W. B. and Boodle, L. A.]—A Hybrid Heath. (Kew Bull., 1911, pp. 378–379.)

Mr. L. A. Boodle studied the structure of the bark of the Beech in relation to attacks of the Beech-Coccus, and began an examination of the anatomy of the seed of some Aroids : see above.

Mr. C. O. Farquharson investigated a disease of Water-lilies.

Mr. J. Fraser, on behalf of Lord Avebury, continued the study of pollen-grains begun in 1909.

Mr. H. B. Lacey began an anatomical and experimental investigation of some examples of succulent leaves.

Mr. A. J. Maslen made a further examination of *Mesoxylon Sutcliffii* for the completion of his paper on this fossil plant : see above.

Prof. W. Rothert studied the chloroplasts and chromoplasts in a number of plants.

Mr. W. C. Worsdell continued the preparation of his morphological work on Vegetable Teratology.

Prof. R. H. Yapp investigated the anatomical structure and development of the leaves of *Spiraea Ulmaria* in order to complete some researches on certain ecological problems presented by this species.

Pathology.—The public generally are beginning to realise that the diseases from which plants suffer may in many instances be due to insects or fungi, hence the quantity of material submitted to

Kew for investigation, and the number of reports issued, increases annually. The exceptionally dry season has obviously favoured the growth and extension of many mildews. Wart disease of potatoes shows a decided tendency to attack above-ground parts of the plant, in addition to the tubers. The gooseberry "Cluster-cup"—*Puccinia Pringsheimiana*, Klebahn—has been exceptionally abundant, especially in Scotland, where the fruit, as well as the foliage, has been attacked.

Attention has been given to the diseases attacking sweet peas, asters, &c. The somewhat obscure disease resulting in the death of rhododendron branches has also been investigated.

Diseased material has also been received at Kew from Queensland, New Zealand, Federated Malay States, Nigeria, &c.

Additions to the Herbarium during 1911.—More than 19,000 specimens have been received as donations or exchanges, and about 7,000 have been purchased. The principal collections are enumerated below.

EUROPE. *Presented*:—A. Jordan's Herbarium, by Miss E. Willmott; Fungi, by Abate G. Bresadola; Russia, by Mr. J. F. Duthie; "Kryptogamae Exsiccatae," cent. xviii. and xix., by the Vienna Hofmuseum; Herbarium Hieraciorum Scandinaviae," cent. xxiii. and xxiv., by Dr. H. Dahlstedt.

Purchased:—Rev. S. Enander, "Salices Scandinaviae," Nos. 101–150; W. Transchel and J. Serebrianikow, "Mycotheca Rossica," fasc. 3–5; H. Sydow, "Mycotheca Germanica," fasc. 20–21; Dr. A. de Degen, "Gramina Hungarica," fasc. 7.

ORIENT AND NORTH ASIA. *Presented*:—Siberia, (V. L. Komarov), through the Imperial Botanic Gardens, St. Petersburg; North-west Mongolia, by Mr. M. P. Price; Turkestan and the Caucasus (F. N. Meyer), through the United States Department of Agriculture.

Purchased:—Th. Strauss, Western Persia.

CHINA AND JAPAN. *Presented*:—Shensi and Kansu, by Sir Alex. Hosie; various, by Mr. W. J. Tutcher.

Purchased:—A. K. Schindler, China; Père E. J. Taquet and Dr. R. G. Mills, Corea.

INDIA AND MALAYA. *Presented*:—Sir G. S. Gough's Herbarium, by the Linnean Society; Col. R. H. Beddome's Fern Herbarium, by Mrs. Beddome; various plants (many Apocynaceae and Asclepiadaceae), by the Royal Botanic Garden, Calcutta; North-West India and Sikkim, by Mr. J. R. Drummond; Burma, by Mr. J. H. Lace; Siam, by Dr. A. F. G. Kerr; Malay Peninsula, by Mr. H. N. Ridley; Philippine Islands, by Mr. E. D. Merrill and Abate G. Bresadola; Borneo, by Mr. H. N. Ridley; Java, by the Leiden Herbarium.

Purchased:—A. D. E. Elmer, Philippine Islands.

AUSTRALASIA. *Presented*:—Western Australia, by Dr. Alex. Morrison; New Zealand, by Mr. T. F. Cheeseman.

Purchased:—Max Koch, Western Australia; Dr. F. Vaupel, Samoa.

Tropical Africa. *Presented:*—Sierra Leone, by Mr. C. E. Lane-Poole; Northern Nigeria, by Dr. J. M. Dalziel and Mr. C. C. Yates; Southern Nigeria, by Mr. and Mrs. P. A. Talbot (through the British Museum), Mr. N. W. Thomas; French West Africa, by Dr. Aug. Chevalier; Somaliland, by Dr. R. E. Drake-Brockman; Belgian Congo (A. Sapin), by the Brussels Botanic Garden, and by the Rev. F. A. Rogers; Angola, Cazengo, by Mr. John Gossweiler; Mozambique, by Mr. M. T. Dawe; North-west Rhodesia, by Miss A. E. Gairdner and Mrs. Macaulay, and by Rev. F. A. Rogers; Bulawayo and the Matoppo Hills, by Lt.-Col. A. F. Appleton.

Purchased:—C. F. M. Swynnerton, Gazaland.

South Africa. *Presented:*—South-west Africa, Percy Sladen Memorial Expedition, Prof. H. H. W. Pearson, by the Percy Sladen Trustees; Transvaal, by Lt.-Col. A. F. Appleton; Basutoland, Dieterlen, by Prof. Ch. Flahault; various, by Mr. E. E. Galpin and Mr. E. P. Phillips.

Purchased:—Miss Olive Nation, Transvaal; Miss M. M. Stewart, Swaziland; Miss Alice Pegler, Kentani; H. Rudatis, Natal.

North America. *Presented:*—Newfoundland, by Mrs. E. G. Britton; United States, by the United States National Herbarium; Bermuda, by the Government of Bermuda.

Purchased:—J. Macoun, Canada; A. A. Heller, Nevada; F. S. Collins, "Phycotheca Boreali-Americana," fasc. 34–35.

Mexico. *Purchased:*—C. R. Orcutt.

West Indies. *Presented:*—Jamaica, by Mr. W. Harris; Jamaica and Bahamas, by Mrs. E. G. Britton; Dutch West Indies, Dr. J. Boldingh, by the Rijks Herbarium, Utrecht.

Purchased:—Baron Türckheim, San Domingo.

South America. *Presented:*—Venezuela, by Mr. W. P. Handover; British Guiana, by Mr. F. A. Stockdale; Brazil, by Mr. F. Theissen; Bolivia, Mr. R. S. Williams (Sir Martin Conway Expedition), by the New York Botanical Garden.

A set of more than 1200 specimens from various localities has been presented by the Paris Herbarium. Mr. F. Stephani has presented specimens of a new species of *Frullania* described by him. Thanks to the kindness of the Bentham Trustees a collection of figures of fungi, including 7000 sheets, the work of Dr. M. C. Cooke, has recently been presented to the Herbarium. Dr. Cooke's original collection has been installed in the Herbarium for some years, and the total number of sheets of the combined collections amounts to 30,000. The majority are original drawings, and range over the entire family of fungi, special attention having been devoted to the delineation of microscopic forms. The specimens collected by Mr. M. P. Price during his recent expedition through North-west Mongolia have been presented by him. The Corean plants received from Père E. J. Taquet consist chiefly of *Cyperaceae*, *Gramineae* and *Leguminosae*. Mr. H. N. Ridley's contribution contains plants collected by him in Borneo

and various parts of the Malay Peninsula, and includes many new species described by him. Dr. A. F. G. Kerr continues to send excellent specimens from Siam. Mr. T. F. Cheeseman has presented additional specimens used in the preparation of his "Illustrations of the New Zealand Flora," the drawings for which have just been completed at Kew. Colonel Beddome's collection forms a valuable addition to the fern herbarium at Kew. Numerous small collections from Tropical and South Africa have been received in addition to those enumerated above.

During the year nearly 6000 specimens have been received on loan in connection with the preparation of the Flora of Tropical Africa and the Flora Capensis, or for clearing up doubtful points.

Presentations to the Library during 1911.—The Bentham Trustees have presented a copy of William Turner's rare little work, *The Names of Herbes in Greke, Latin, Englishe, Duche and Frenche, wyth the commune names that Herbaries and Apotecaries use*, a small octavo of 64 leaves published in 1548. On account of the rarity and interest of the volume, a reprint, edited by Mr. James Britten, was published for the English Dialect Society in 1881. A copy of *De historia stirpium commentarii insignes* (Lugduni, 1549), by L. Fuchs, in which the fine illustrations of the folio edition of 1542 appear in a very much reduced form, has also been added to the library by the Bentham Trustees and the issues for the year of about thirty serial or periodical works, continuing sets which have been acquired by the same means. In previous notes on presentations to the library references are made to Boudier's *Icones Mycologicae*, a costly work comprising 600 coloured plates and a volume of text. The plates were issued in six series, beginning in 1905, and during the current year the work has been completed by the publication of the volume of text, for a copy of which the establishment is indebted to the Bentham Trustees.

The late Sir J. D. Hooker, O.M., G.C.S.I., continued to the end of his long and brilliant career to manifest in every possible manner his profound interest in the welfare of the various departments at Kew. For many years he gave to the library his personal copies of several of the publications issued by the numerous learned societies and academies of which he was a member, and these now form long series of volumes which are indispensable to the efficient working of the establishment.

From the Trustees of the British Museum has been received the second part of *A Monograph of British Lichens*, by Miss A. L. Smith. The first part, by J. M. Crombie, presented by the same Trustees, was published in 1894.

The Secretary of State for India has presented *The English Factories in India*, by W. Foster. The last volume of the five now issued covers the period from 1634 to 1636. To him also the library is indebted for a copy of the fourth edition of vol. iii. of *Schlich's Manual of Forestry*.

Sir Frank Crisp has presented the *Flora von Thüringen und den angrenzenden Provinzen*, by J. C. Zenker, D.F.L. von Schlechtendal and L. E. Langethal, the drawings by E. Schenk. The work is in twelve small octavo volumes and includes 1439 well-executed plates. *Fleurs des champs et des bois des haies et des murs*, by H. Correvon, has also been presented by Sir Frank Crisp.

A handsome quarto volume entitled: *A Research on the Pines of Australia*, has been received from the authors, Messrs. R. T. Baker and H. G. Smith. The "Pines" of this work belong to the eleven different genera of the Coniferae inhabiting Australia, the largest of which is the genus *Callitris*, with 18 species. *Pinus* itself is not represented in Australia. The present work forms a companion volume to that issued in 1902 on the Eucalypts, which were dealt with by the same authors, who kindly gave a copy to the Kew library.

Dr. Auguste Chevalier has just published under the title *Sudania*, the first volume of an enumeration of the plants collected by him in Tropical Africa, during the years 1898 to 1910. The determinations are in numerical order from no. 1 to no. 12,000, and have been supplied by various botanists. Only 35 copies of the work, which has been reproduced by lithography, have been issued. A copy has reached Kew from Dr. Chevalier, also the sixth fascicle of his work, *Les Végétaux utiles de l'Afrique tropicale.*

Die Vegetation des Untersees (*Bodensee*), by E. Baumann, and *Beiträge zur vergleichenden Anatomie und zur Systematik der Connaraceen*, by G. Schellenberg, are dissertations presented to the library by Dr. Hans Schinz.

Lieut.-Col. J. J. Wood, I.M.S., has presented the manuscript, with additional notes, of his treatise on the Plants of Chutia Nagpur, which forms vol. ii. no. 1, of the *Records of the Botanical Survey of India*; also an interleaved and copiously annotated copy of the published work.

The Index to the second edition of Iinuma Yokusai's *Sōmoku-Dusets* has been added to the library by Mr. T. Makino, through the kind offices of Dr. B. Hayata.

From the University Press, Berkeley, California, has been received a copy of Dr. W. L. Jepson's *Silva of California*, a handsome quarto volume including 85 plates and 3 maps. It forms vol. ii. of the *Memoirs of the University of California*. A copy of Dr. Jepson's *Flora of Western Middle California*, second edition, has been received from the author.

A much enlarged edition of the *Farm Weeds of Canada*, by G. H. Clark and J. Fletcher, elaborately bound, has been presented by the Canadian Government Exhibition Commissioner at the Festival of Empire held at the Crystal Palace during the summer. This work, which contains 76 coloured plates of considerable merit, must be of great value to those for whom it is designed.

Mr. J. H. Maiden has sent parts 12 and 13 of his *Critical Revision of the genus Eucalyptus*, and parts 2 and 3 of his *Illustrations of New South Wales Plants*, as well as reprints of his papers from various Australian societies' journals. The issues for the year of this author's *Forest Flora of New South Wales*, which now extends to part 5 of vol. v., have been received, as were the issues of previous

years, from the Honourable the Secretary for Agriculture, New South Wales. A duplicate set of parts 1 to 36 of this work have been presented by Mr. Finlay Sanderson.

The third part of vol. ii. of *Trees and Shrubs*, edited by C. S. Sargent, has been received from the publishers of the work, Messrs. Houghton Mifflin Company. A note on this valuable publication appeared on p. 382 of the *Kew Bulletin* for 1911. *Plantae Wilsonianae*, an enumeration of the woody plants collected in Western China for the Arnold Arboretum during the years 1907, 1908, and 1910, by E. H. Wilson, is also edited by Prof. Sargent, who has presented the first part issued last July.

A Dictionary of Plant-names, by H. L. Gerth van Wijk, a quarto volume of 1444 pages, has reached the library from the Dutch Society of Sciences, Haarlem. In this volume the arrangement is according to the Latin names, under which are given as far as known the English, French, German and Dutch names. A second volume, in which the common names in the languages mentioned will be alphabetically arranged and followed in each case by the Latin name, is in preparation.

Mr. and Mrs. Antony Gepp have presented a copy of their beautifully illustrated work, *The Codiaceae of the Siboga Expedition. Études sur la Flore des Districts des Bangala et de l'Ubangi (Congo belge)*, by E. De Wildeman, has been received from Messrs. Misch & Thron of Brussels; *Genesis and Development of Sand Formations on Marine Coasts*, by Pehr Olsson-Seffer, from the Board of Directors of Augustana College and Theological Seminary, Rock Island, Illinois; *Die palaeobotanische Literatur*, edited by W. J. Jongmans, vol. ii., from the Direction, 's Rijks Herbarium, Leiden; *Papers and Reports on Cotton Cultivation* (International Association of Tropical Agriculture and Colonial Development), by W. R. Dunstan, from the author; *Icones Orchidearum Austro-Africanarum*, by H. Bolus, vol. ii., from Miss L. Kensit; *The African Rubber Industry and Funtumia elastica*, by C. Christy; *Orchids for everyone*, by C. H. Curtis, from Mr. A. W. Hill; the second part of Dr. Glück's *Biologische und morphologische Untersuchungen über Wasser-und Sumpfgewächse*, from Dr. O. V. Darbishire.

Mr. W. Botting Hemsley has presented *Chloris Platensis Argentina*, by C. M. Hicken, a second copy of *The North American Species of Panicum*, by A. S. Hitchcock and Agnes Chase, and *El Jardin Botánico de Buenos Aires*, by C. Thays. A second copy of the last named work has also been received from the author.

The Physiography of the River Nile and its Basin, by H. G. Lyons, has been presented by the Director General of the Survey Department, Egypt.

Treatises on Algae by M. H. Foslie, Madame Paul Lemoine, and C. J. F. Schmitz, and other papers have been received from their authors, amongst whom may be mentioned Dr. V. F. Brotherus, Dr. C. C. Hosseus, Mrs. Koorders-Schumacher, Messrs. G. Massee, F. Theissen, H. S. Thompson, and Dr. Karl Rechinger, the publications appearing under their names in the supplement to

the Library Catalogue, which will form Appendix II. of the *Kew Bulletin* for 1912.

The establishment is indebted to the Director of the Department of Agriculture, Buitenzorg, the Director of the Agricultural Research Institute, Pusa, Bengal, and the Secretary of Agriculture, Washington, for the numerous valuable publications received from them, most of which are periodicals or serials continuing sets in the library.

An excellent wall map of the Malay Peninsula, compiled by and published for the Straits Branch of the Royal Asiatic Society, Singapore, has been presented by the Society through the kind offices of Mr. H. N. Ridley.

Botanical Magazine for January.—The plants figured are *Begonia* (*Knesebeckia*) *dichroa*, Sprague (t. 8412); *Elliottia racemosa*, Muhl. (t. 8413); *Berberis Wilsonae* Hemsl. (t. 8414); *Disa* (*Herschelia*) *lugens*, Bolus (t. 8415); *Calceolaria cana*, Cav. (t. 8416).

The Begonia is an interesting plant with peculiar shining orange-scarlet flowers. Though placed in the section *Knesebeckia* it occupies a somewhat isolated position and shows striking resemblance to *B. maculata*, Raddi, of the section *Gaerdtia* in which the two segments of the placenta bear ovules on their outer surfaces only. *B. dichroa* may therefore be a hybrid between two species belonging to different sections, but there is no direct evidence in support of this view. The subject of the plate was obtained from Messrs. Haage & Schmidt, Erfurt, in 1907.

Elliottia racemosa is a shrub or small tree now confined to a very small area in northern Georgia and South Carolina, where it is a rare plant. The Kew plants were received from the late Mr. P. J. Berckmans, in 1902, a previous attempt to introduce it in 1894, having failed. One of the plants flowered well in July last, and its racemes of sweet-scented waxy white flowers were quite beautiful. The buds at first pendulous become erect shortly before expanding and the flowers when open are in a more or less horizontal position. Unfortunately all attempts to produce seed have failed.

Among the many new forms of *Berberis* recently introduced from China *B. Wilsonae* is one of the most distinct and attractive. It was found by Mr. E. H. Wilson near Tatien-lu in 1903, and was presented to Kew by Messrs. J. Veitch & Sons in 1907. It is a dwarf spreading plant suitable for rock garden culture, and at Kew the young plants tend to retain their foliage during the winter.

Disa lugens is one of the "blue" Disas. Formerly it was confused with the nearly allied *D. barbata*, Sw., but is easily distinguished by the metallic greenish-purple hue of its flowers. In South Africa it is found on the Cape Flats in moist sandy soil among *Restiaceae* at about 100 feet above sea level. The specimen which forms the subject of the plate was received from Mr. H. J. Elwes of Colesborne.

The *Calceolaria* was raised from seed purchased in 1910 from Mr. J. D. Husbands, Limavida, Chile. It is one of the species peculiar to that country and has been collected by Mr. Elwes as far south as the Baños de Chillan in Nuble at 5000–6000 feet above sea level, and by Prof. Philippi as far north as the province of Coquimbo. The plant bears a striking resemblance when not in flower to a *Stachys* or a *Gnaphalium* with its white woolly leaves. The flowers are borne in elongated lax corymbose inflorescences, and are pale violet or rose-coloured with a scent of violets.

Rubber-yielding Plants from Peru.—Mr. W. Fox, on a recent journey in the territory between the rivers Putumayo and Caquetá, collected five rubber-yielding plants, about which he has furnished the following particulars :—*Hevea Foxii*, Huber, is by far the most common and the best rubber-yielding species, and is the source of the Para rubber of commerce from this region. This species bears the vernacular name of Ituri or Iserai, but these names also appear to be applied to another species of *Hevea*, allied to *H. lutea*. Of the rubber exported from this region 75 per cent. is derived from *Hevea Foxii*, and these trees are the only ones which are properly tapped. All the other rubber plants are cut down for the extraction of their latex.

The *Hevea* is tapped by incisions made with a machete, and the latex is allowed to run down the tree to the ground, where it coagulates. The rubber is recovered in strips, which are taken to a stream and washed, and it is then rolled into rabos or tails, in which form it arrives in London. This crude method is due to the wide area over which the trees are scattered.

Micrandra minor, Benth., bearing the vernacular names Huemega or Wakati Ewickeri, was found fairly evenly distributed, but was becoming scarce owing to the destructive methods of working. The latex of this tree is mixed with that of the *Hevea*, and is also used for wrapping the rabos or tails.

A species of *Castilloa*, probably *C. elastica*, though somewhat different from the type, was also collected, but as leafy specimens only ; it bears the name Caucho negro or Efacone. It is only found in quantity near the Caquetá and Putumayo rivers. The sections where the valuable *Castilloa* occurs have not yet been much worked, so that its destruction is not so marked as is the case with the other trees.

Another tree yielding rubber is the Minyadotana, a new species of *Zschokkea* described in *K.B.* 1912, p. 38, under the name *Z. Foxii*, Stapf. The tree is not very widely spread, and is becoming scarce owing to the methods of working. The latex is used for mixing with that of the *Castilloa* and the *Hevea*.

Lastly, a gutta-yielding plant was found which is probably *Sideroxylon cyrtobotryum*, Mart. This plant, which is known by the native name Arórate, is rare and was met with only at Oriente, near the Igara Parana, and the yield is therefore a negligible quantity.